Better Crops WITH PLANT FOOD

April 1952 10 Cents

(*Turn to page* 32)

The Pocket Book of Agriculture

INTRODUCING the New

AGRICULTURAL PENTAHYDRATE BORAX

The introduction of this new product to the agricultural trade represents an achievement in product research and development designed to provide a high analysis fertilizer grade Borax at minimum cost.

CHARACTER OF PRODUCT Contains a minimum of 44% B_2O_3 or approximately 121% equivalent Borax.

ADVANTAGE More economical because the Borate which comes to you in this form is more concentrated.

PURPOSE To correct a deficiency of Boron in the soil and thus enhance the productivity of crops.

RECOMMENDED USES As an addition to mixed fertilizer, or for direct application to the soil.

FOR CORRECT APPLICATION Consult your local County Agent or State Experimental Station.

A member of the well-known "Three Elephant" Boron product family.

AMERICAN POTASH & CHEMICAL CORPORATION

122 EAST 42nd STREET • • • NEW YORK 17, N. Y.

231 S. LA SALLE STREET
CHICAGO 4, ILLINOIS

214 WALTON BUILDING
ATLANTA 3, GEORGIA

3030 WEST SIXTH STREET
LOS ANGELES 54, CALIF.

"Pioneer Producers of Muriate in America"

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXVI NO. 4

TABLE OF CONTENTS, APRIL 1952

Farmers and Foreigners 3
Jeff Considers the Relationship

Efficient Use of Fertilizer in the Southern Region 6
W. E. Colwell Presents His Ideas

The Inorganic Side of Life 10
Ably Discussed by Firman E. Bear

Use of a Soil Test Summary in Agronomic Programs 15
C. D. Welch Details the Opportunities

Tomato Production for the Canning Industry 21
Jackson B. Hester Outlines Essential Factors

No More Fodder Pullin' 24
T. S. Buie in Reminiscent Mood

Soybeans Need Fertilizer on Many Arkansas Rice Farms 26
R. L. Beacher and E. M. Cralley Tell Why

Potash for Pecans 47
Some Results Reported by Clyde Beale

The American Potash Institute, Inc.

1102 16th Street, N. W., Washington 6, D. C.

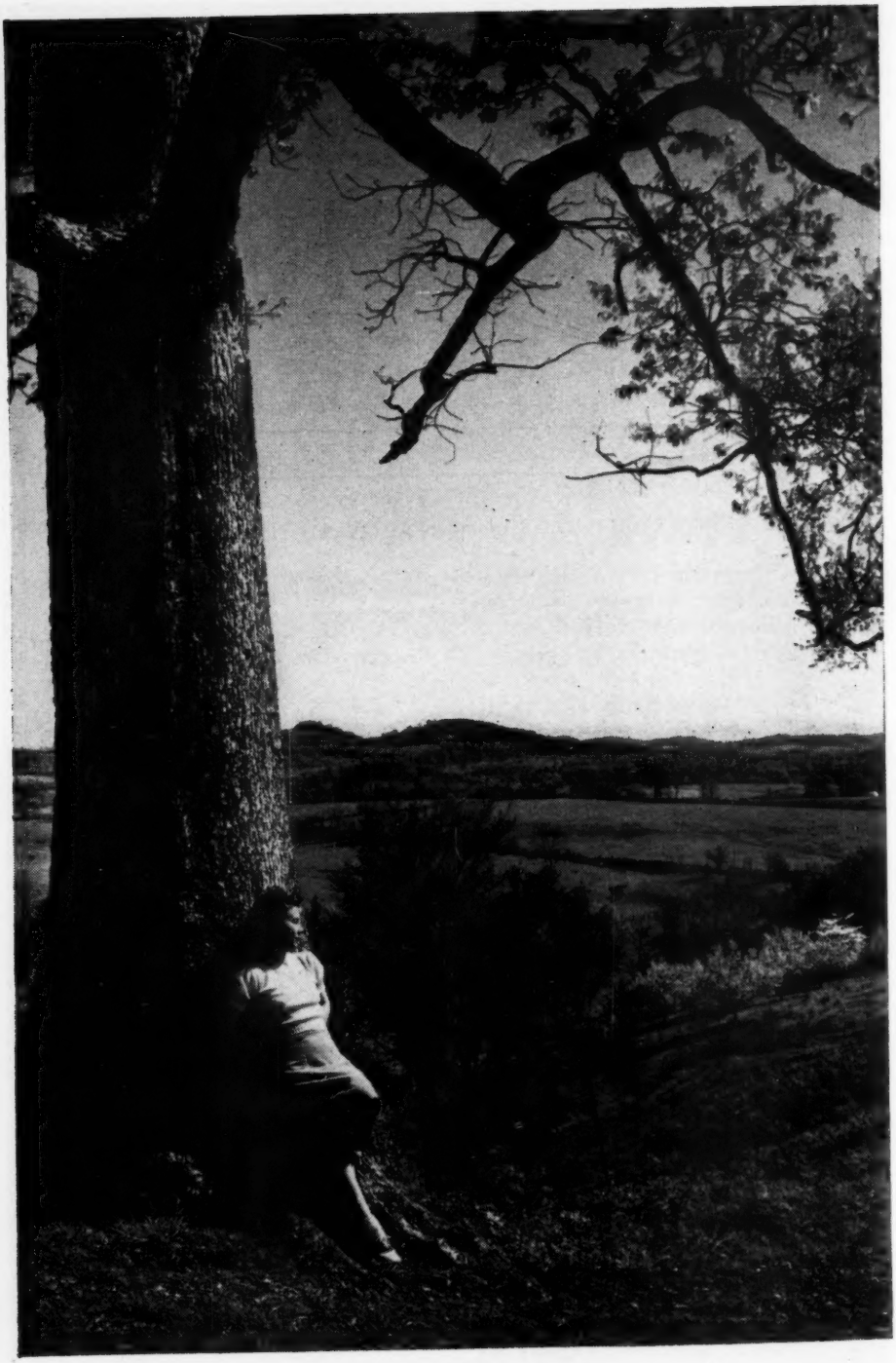
Member Companies: American Potash and Chemical Corporation
United States Potash Company
Potash Company of America

Washington Staff

H. B. Mann, *President*
J. W. Turrentine, *President Emeritus*
J. D. Romaine, *Chief Agronomist*
R. H. Stinchfield, *Publications*
Mrs. H. N. Hudgins, *Librarian*

Branch Managers

S. D. Gray, *Washington, D. C.*
J. F. Reed, *Atlanta, Ga.*
G. N. Hoffer, *Lafayette, Ind.*
M. E. McCollam, *San Jose, Calif.*
E. K. Hampson, *Hamilton, Ont.*



Spring Thoughts

Better Crops with PLANT FOOD

PUBLISHED BY THE AMERICAN POTASH INSTITUTE, INC., 1102 SIXTEENTH STREET, N.W., WASHINGTON 6, D. C., SUBSCRIPTION, $1.00 FOR 12 ISSUES; 10¢ PER COPY. COPYRIGHT, 1952, BY THE AMERICAN POTASH INSTITUTE, INC.

VOL. XXXVI WASHINGTON, D. C., APRIL 1952 No. 4

Considering . . .

Farmers and Foreigners

Jeff McDermid

FARM organization representatives, rural school leaders, members of home demonstration extension staffs, and officers of rural homemakers' clubs took active part in the work sessions and panel discussions which I was privileged to attend during the Third National Conference of the U. S. Commission for the United Nations Educational, Social, and Cultural Organization. It was held in Hunter College, New York, late last January. The perplexing questions confronting our rural areas in this hour of decision about financing foreign cooperative efforts were previewed during that meeting.

They asked themselves how rural communities and farm groups can learn more about the United Nations and the many-sided program in its name which is designed to create a better and a happier world. (This does not of itself include the famous Technical Cooperation Administration which is separately administered through the State Department, the Land-Grant Colleges, and the U. S. Department of Agriculture.) As a corollary to the first question, the farm folks also wanted to find out what aid and comfort they can give to help reduce the threat of hunger abroad and to assist backward countries to gain stability and progress through science and education.

The UNESCO Commission is named by the Secretary of State, to include not more than 60 representatives of the principal voluntary organizations interested in the subjects named in the UNESCO title. Besides these, not over 40 persons representing State and Federal governments plus 15 members at large are listed.

For rural participants there was a general panel group discussion on world food problems and a series of working group sessions. Two of the three discussion group leaders in the rural field were personally experienced in leading project work abroad in some form of U. S. technical assistance. They were Paul Miller, Director of Extension at the University of Minnesota, who helped set up agricultural extension courses abroad, and Dean Joseph Carrigan, Vermont University, who was Director of the Economic Cooperation Administration mission to Ireland for two years. The third group leader, experienced in many such sessions, was J. P. Schmidt, Extension Service, Ohio State University. Director of Federal Extension, M. L. Wilson, held the chair during the initial panel discussion.

DELEGATES were faced with some basic situations which must be fully grasped before any sound and lasting program can be launched from the grassroots. To begin with, all the food produced in this country cannot go far in filling the enormous gap between supply and demand. This is simply because our farmers are no more than three-tenths of one per cent of the two-thirds of the world's workers who are living on the land.

Some believe that even if we could find the amount and quality of food needed to restore a semblance of good nutrition to starving people over the world, we would not have the answer. This, they claim, is because distribution is the weak link—that and the natural earning power of the hungry people which must be greater than it is now in order to feed themselves from what they themselves earn. To feed millions forever in poverty and in the handout bread-line is a poor way to stabilize the world's populations and give them dignity and self-confidence. If there is no way to unite nations in order to promote a greater degree of purposeful production and international exchange in commerce and currency, then our goal is a longways off.

As for our part in it, most of our farm spokesmen agree that for us to share our experience and technical abilities is better than to use the dole method persistently. Foreigners like that way better, too. They mostly prefer to learn more about our productive ways and means than to take charity in any form. Here again, of course, we run against the same old snag in the stream of life—that all the technical learning we can stuff into them will never take the place of a reorganized world system which gives the common man a living wage and a steady job. I am not radical in this viewpoint because many of the experienced leaders in these days of overseas exertion will tell you the same.

YET nobody can deny that a man who is prepared to undertake to show his backward neighbors how to produce more and better is a tower of potential strength—and what he has learned in this country may be a godsend in thousands of small affairs and local enterprises. Many examples of such success arising from adopting modern methods by gradual degrees are scattered through the current reports of Food and Agriculture Organization.

Few nations have sizable amounts of food for export in world trade channels. Communists shut off the Danube Basin and most of Asia, and they were once tremendous exporters of surplus food products. With the great rise in populations everywhere, most nations need more of their own production at home—if they can produce it. It is our avowed policy here to export all the food which other nations can buy from us. However, our own home reserves are on a lower level for the moment, and the outlook for the harvests of 1952 is none too promising. The U. S. has approached the limit of its food export capacity, and letting more for-

eigners in to share our abundance is still a topic of wide disagreement.

Continued and expanded technical assistance in agricultural production and processing was seen as the best bet by most of the debaters at the panel session. Today there are nearly a thousand technical workers from this country in various far-flung regions of the world, performing every known teaching task—from cooking lessons and health promotion to fighting Asiatic locust swarms. Since that panel was held, however, the director of Point Four campaigns in agriculture has

stated that if we can't actually show a distinct gain in the food and nutrition of the foreigners we have assisted within four or five years, we might as well quit.

Food and Agriculture Organization's North American Office was represented at the New York panel session. Reports of past progress were recited and some hopes for the future were given. For one thing, their public relations spokesman stated flatly that the period of huge publicity campaigning in behalf of world food production efforts on the dollar-spending basis has passed, and that our reliance must be placed upon sentiment springing from local organizations to be of service in the cause of humanity and good will. But this voluntary support from local sources must be secured without high-pressure methods, it was declared.

In the group deliberations rural opinion was frank and firm, based on previous experience in setting up local mediums of support to work against forces that divide and disrupt world harmony and understanding. No formal resolutions or recommendations were drafted. There were, however, concluding reports filed with UNESCO by the three Extension Service chairmen.

Stated in summary form, the gist of the thinking by the farm representatives followed a general pattern like the following, with no "spoon-feeding" or prompting from any government agency: What is the role of farm and rural organizations in relation to the United Nations and its specialized agencies?

Rural organizations already play a major role in this effort and will continue to do so. No broad, inclusive, blanket endorsement was suggested for the entire program of UN. The creation of an understanding of a world community and the interdependence of all nations are believed to be the main guiding principles which the folks back home will follow. The interoffice relations and formal functions set up by UN are of no momentous concern to the rural rank and file, who look to a more tangible goal.

INFORMATION and education are the tools these rural folks want put to good use abroad. They would like to achieve some progress without forgetting differences between strictly national problems and those of an international kind. They admit that considerable animosity and prejudice exist and must be overcome—both in our own country and overseas. That some of this letdown in the fever for world betterment is due to Communism's ruthless work was recognized, but plenty of it stems from those who claim we are overlooking and postponing our own needful reforms and services while we do foreign missionary effort.

(*Turn to page* 49)

Efficient Use of Fertilizer in the Southern Region

By W. E. Colwell

Department of Agronomy, University of North Carolina, Raleigh, North Carolina

IN 1952, the Nation's farmers are being asked to produce more than they ever have produced before. The goals are set above the 1951 production—about 50% more than before World War II. In the entire Nation and especially in our area where production is so closely related to fertilizer use, every effort needs to be made to maximize return on each fertilizer increment. Experimental evidence should be examined critically to discover those crops and situations where returns are greatest.

Data from both sides of the state line should be examined. All available facts need to be brought forth. Agronomists and horticulturists in the various states, together with industry, have a real responsibility in the period immediately ahead to direct thinking on more efficient use of fertilizers. Attention should be given to pointing up two types of situations in the various states: (1) On what crops and under what conditions can less of any one particular element be used without cutting production materially? and (2) On what crops and in what situations can greater than presently used quantities of each element be used profitably? Let us keep in mind that the population is going up at the rate of 2½ million per year. Each morning the United States has an additional 7,000 people to feed. Besides the increase in numbers, per capita consumption is higher than it was in the prewar period.

As an aid in meeting the responsibility with respect to feeding the people, agronomists and horticulturists have accumulated during past months all available data on the response of crops to fertilizer. These were tabulated and issued as a preliminary report in August 1951. The report will be reviewed and prepared for publication in final form during the year. The purpose of the discussion to follow is to point up certain adjustment opportunities in our region as examples of means whereby greater economy in fertilizer usage can be attained. In so doing we want to look ahead to 1955 in examining our opportunities for more efficient fertilizer usage and crop production during this period. In reviewing the large volume of data, there are, in my opinion, a number of points which seem to be especially important for the region as a whole.

The Opportunities

Corn represents a No. 1 opportunity. At the present time the average fertilization rate in the Southern Region is 15 lbs. of N, 13 lbs. P_2O_5, and 9 lbs. K_2O per acre. The Department of Agriculture's program for the expansion of fixed nitrogen capacity by 900,000 tons of N by 1955 has been approved by the Defense Production Administration. Little increase is expected before 1953 or 1954. This figure of 900,000 tons compares with a total of 1,285,000 tons used by Agriculture in 1950-51. The anticipated increase is more than we used in the whole U. S., Hawaii, and Puerto Rico in 1947-48. How can we use effectively the 900,000 new tons in 1955? This problem cannot be answered simply. It will require study in each state. It is interesting, however,

Fig. 1. The response of wheat to nitrogen: left—no nitrogen applied; right—45 lbs. N per acre. Note the difference in number and size of tillers. These are forerunners of yield.

to speculate now. If we assume that half of this 900,000 tons is to be used in our region (this is close to the proportion we used in 1949-50) our problem is how to use an extra 450,000 tons wisely. Even though this seems like a lot of nitrogen, and it is, it could all be used on the 24 million acres of corn spreading it at the rate of 37.5 * lbs. N per acre. This, on top of our 15 lbs. now used, would make only 52.5 lbs per acre—far below that recommended rate for top yields. This does not imply that all of our extra nitrogen in 1955 should go on corn. I am sure there would be other places for some of it. Cotton is receiving only 14 lbs. per acre in the region as a whole. Experimental results show that higher rates of nitrogen should be used on cotton. Our 16 million acres of wheat are receiving an average application of 2 lbs. of nitrogen per acre. If Oklahoma and Texas are not considered in this, the average N application on wheat in the other Southern states is near 15. In my state the figure is 14, some 30 lbs. less than recommended.

* If the approximately 4 million acres of corn in Texas and Oklahoma with the low average rate of between 2 and 3 lbs. N per acre are not considered, this figure would become 45.

Increased phosphate and potash on pastures and hay crops present a challenging picture. The first problem is to maintain adequate lime which is far from reality in many areas; but assuming lime is not limiting, the production from increased use of P and K on forages is striking. Alfalfa yields in Virginia, for example, can be increased 59% by a threefold increase in phosphate (increasing from 40 to 120 lbs.); 14% by 40 lbs. more K_2O per acre. On ladino clover pasture in North Carolina, tripling the average phosphate application, raising it from 19 lbs. P_2O_5 per acre to 57, will result in a 48% increase in production. Raising the potash level from 15 to 45 lbs. per acre will bring about a 22% yield increase.

Up to now I have talked entirely about possible opportunities for utilizing *more* N, P_2O_5, and K_2O. We note, however, that we don't have *more* of everything, for the coming season only a slight increase of 7% N and 5% K_2O with a reduction in P_2O_5 of the order of 6%. Thus it is that just as vital a part of the question is from where do we get N, P_2O_5, K_2O to use as illustrated above? An examination

of the data reveal some possibilities. I shall mention some of these on regional basis, realizing an individual state approach may be different in detail.

Current use of phosphate on tobacco is 89 lbs. P_2O_5 per acre in the region as a whole. To illustrate the type of economy that can be effected I am going to consider the case of tobacco in North Carolina. The shift from 3-9-6 to 4-8-10 on all tobacco in 1952 would result in a saving of 14,654 tons P_2O_5. This calculation is based on 757,697 acres (744,348 flue-cured and 13,349 burley) and assumes an average application of 1,000 lbs. of 4-8-10 as compared to 1,333 pounds of 3-9-6. This saving is more than enough to take care of our 6% phosphate reduction which would amount to less than 9,000 tons. Further saving of approximately 800 tons P_2O_5 can be effected by substituting 8-0-24 topdresser for the former 5-5-20 grade. Thus, on tobacco alone we could save 15,454 tons P_2O_5 without decreasing production at all. If used on pastures in North Carolina this would supply enough phosphate to provide a triple rate (57 vs. 19) on 813,000 acres in order to realize that increase of 48% in production referred to earlier. Tripling the phosphate rate on ladino clover pastures would result in 2,000 lbs. more forage per acre.

Converted to beef, this means 104 lbs. more per acre from our 38 lbs. P_2O_5. Since we would have saved enough phosphate to triple the phosphate on 813 thousand acres, the total would be 84,552,000 lbs. of beef or equivalent to 84,000 steers weighing 1,000 lbs.

I have selected this one example from my own state and though I could list others from different states within the region I am of the opinion that individual state workers are in a far better position to examine their particular situation. In all probability the Irish potato problem will bear close study in

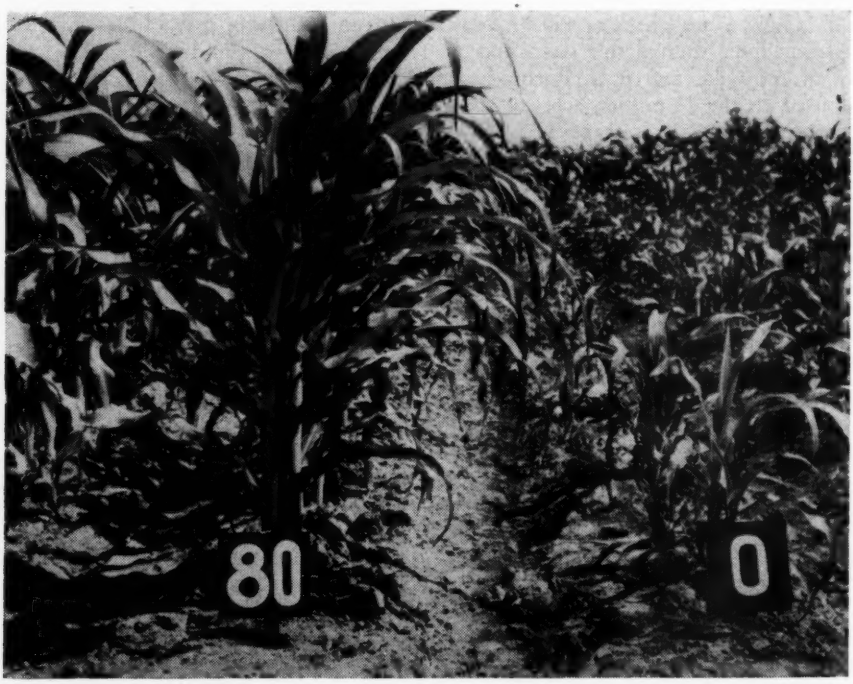


Fig. 2. The response of corn to phosphate: right—no phosphorus applied, yield 41.5 bushels; left—80 lbs. P_2O_5 applied, yield 81.5 bushels.

Fig. 3. The response of cotton to potash: left—66 lbs. K_2O; right—16 lbs. K_2O. The cotton with insufficient potash has lost all of its leaves before maturing a full crop.

a number of the states. With an average P_2O_5 application of 120 lbs. in the Southern states there would seem to be more room for economy. I think there may be some savings possible with respect to vegetable fertilization. The acreage in our Southeastern region is 1,750,000 with an average P_2O_5 application of 72 lbs. Even 5 lbs. per acre saving would result in 4,375 tons P_2O_5. It may be, too, that an examination of tree fruit fertilization would suggest economies, the application of phosphate on fruits and nuts being 43 lbs. P_2O_5 but state averages going up to 100. With an acreage of 1,900,000 in the region, a reduction of 5 lbs. P_2O_5 per acre, if it could be effected without appreciable loss of yield, would result in 4,750 tons P_2O_5 for use elsewhere.

Although we are not faced with an over-all reduction in potash, data should be examined to see if this element is being used as effectively as possible. I call attention again to the fact, for example, that the average application of potash for corn is 9 lbs. per acre. If all the 5% increase in K_2O we can expect this year were used on corn, it would provide only 2 more pounds on over 24 million acres. We could re-raise the same question as to whether 11 lbs. K_2O per acre were enough for corn.

These illustrations point up the necessity for each state to examine its own situation to see how effectively the limited supply of nutrients is being used. New technology will modify trends and decisions. It appears, for example, that potassium sulfate may be superior to potassium chloride for Irish potatoes. The sulfate-fertilized potato is of a higher quality, with a higher dry matter content, and stands up better under certain storage conditions. More information is being obtained all the time on proper use of minor elements. The suitability of mineral nitrogen for tobacco and the economies effected upon these substitutes for the more expensive organic sources will need to be considered in getting the most from every fertilizer dollar.

After the various shifts which seem desirable are decided upon, there remains the difficult task of getting the job done. In this, the help of industry is essential. The necessary adjustments may involve grade changes, new ratios, or new practices on the different crops.

The Inorganic Side of Life

By Firman E. Bear

Soils Department, Rutgers University, New Brunswick, New Jersey

IN the introduction to Justus von Liebig's century-old book on "Organic Chemistry in Its Application to Agriculture and Physiology," two fundamental principles are presented. The first is that "the primary source whence man and animals derive the means of their growth and support is the vegetable kingdom." The second is that "plants find new nutritive material only in inorganic substances."

Green plants are derived almost entirely from inorganic matter. Little more than the spark of life is passed on directly from one generation to the next. The essential elements for growth and reproduction are obtained from soil, air, and water, and they again become soil, air, and water at the end of each cycle of their use. A cycle may be completed in an hour, a day, or a week. It may require a month or a year. But frequently it is not accomplished for centuries or ages. Yet only as such cycles are completed can plants continue to grow and reproduce.

Although the earth constitutes an essentially fixed quantity of mineral matter, far-reaching changes in the form and distribution of this matter have taken place during the 2 billion years of the earth's existence. As the original rock that made up the earth's crust was reduced to soil, enormous tonnages of soluble salts were lost to the sea. Vast quantities of carbon were withdrawn from the air in the formation of coal, petroleum, coral, and limestone. The mobility of water was greatly lessened by its becoming a part of the crystalline structure of minerals and by its being held more firmly by the salts in the sea.

In due time, simple one-celled forms of life came into being. Out of these, the very dense vegetation and the gigantic dinosaurs of the palaeozoic and mesozoic eras gradually evolved. These eventually yielded to more highly developed forms of life. Some 60 million years back the primate family appeared. Finally, about a million years ago, the forerunner of modern man came into being. Wide differences in requirements have developed between the highest forms of plant and animal life, even though they evolved from a common or very similar heritage.

Selective Process

There is little similarity in the chemical composition of soil and that of the green plants that grow on it. Very marked differences occur between the composition of crop plants and that of the microbes and animals that consume them (Table I). Oxygen is a dominant element in all four entities. In the soil, this oxygen is largely associated with silicon, aluminum, and iron. In the corn plant, it is tied fast to carbon and hydrogen. In microbe and man, it is more largely associated with nitrogen. Silicates are the primary constituents of the soil, whereas carbohydrates are dominant in crop plants and proteins in microbes and man. Thus the selective process operates between the soil and the green plant and again between the green plant and the animal that consumes it.

Crop plants tend to accumulate potassium from the soil, whereas animals accumulate calcium, phosphorus, sul-

TABLE I.—PERCENTAGE COMPOSITION OF THE EARTH *, A CORN PLANT, A MICROBE, AND MAN

Elements	The Earth	Corn Plant	Azotobacter	Man
Oxygen	50.02	44.57	25.00	29.13
Silicon	25.80	1.17	.....	.....
Aluminum	7.30	0.11	.....	.....
Iron	4.18	0.08	0.06	0.01
Calcium	3.22	0.20	0.24	3.75
Sodium	2.36	0.10	0.04	0.40
Potassium	2.28	0.92	1.98	0.90
Magnesium	2.08	0.18	0.49	0.10
Hydrogen	0.95	6.26	8.00	8.40
Titanium	0.43	.....	.....	.....
Chlorine	0.20	0.14	.....	0.40
Carbon	0.18	43.70	50.00	45.00
Phosphorus	0.11	0.18	2.10	2.50
Sulfur	0.11	0.17	0.12	0.60
Nitrogen	0.03	1.46	11.30	7.50
All others	0.75	0.76	0.67	1.31
	100.00	100.00	100.00	100.00

* Outer crust of the earth, including the water of the oceans, lakes, and rivers and the surrounding atmosphere. The compositions of the plant, the microbe, and man are on the dry-weight basis.

fur, and sodium, in the order indicated. If elements are regularly found in quantity in any group of organisms, it is safe to assume they have special value to that group.

If a plant has a purpose in life, that purpose is to reproduce itself. The resulting product may or may not be good food. A pine tree, for example, has little or no food value in its natural state. Nobody is tempted to eat cotton and only a few hardy souls swallow tobacco. Some plants accumulate toxic mineral elements, such as molybdenum and selenium. Others synthesize such organic toxins as oxalic and benzoic acids.

The chemical composition of plants varies from species to species and from variety to variety. Even plants of the same strain differ greatly in composition, depending upon the environment under which they have been grown. Both heredity and environment are involved in determining the chemical makeup of every living thing and of its several parts. The effect of environmental factors is clearly indicated in the mineral composition of Rutgers tomatoes that were collected from 10 states (Table II).

Samples of snap beans, cabbage, lettuce, and spinach from these same states were also analyzed. From an examination of 206 such samples, it was concluded that the percentages of ash, calcium, potassium, and most of the minor elements tend to rise from East to West. The percentages of sodium and manganese, however, tend to fall. Magnesium values are especially low in the Atlantic Coast area. Phosphorus values in vegetables are relatively constant. But forage has often been found to be so low in phosphorus that it does not supply enough of the element to meet the needs of livestock.

In experiments with Ranger alfalfa, we found that its potassium content, at the blossom stage, could be made to vary from less than 1% to more than 3%. In proportion as more potassium was available for absorption, the amounts of calcium, magnesium, and sodium in the plants were reduced. But if quantities of all four of these elements were calculated in terms of equivalents, the summation values for the whole plants, including roots, were often remarkably constant (Table III).

Potassium is the dominant mineral cation in plants. If an excess of potassium is available to the crop, so much

of it may be absorbed as to result in a deficiency of one or more of the other mineral cations. The widespread deficiency of magnesium on the Atlantic-Coast Plain is due, in large part, to the very liberal use of potassium fertilizers in that area. The answer to this problem does not necessarily lie in using less potassium but in the use of more magnesium.

Under uniform environmental conditions, the summation values of the mineral anions in plants also tend to be constant. This constancy, like that of the cations, is improved by including the roots. Summation values of both cations and anions are altered by changes in environment, largely by reason of differences in the carbohydrate content of the plants. The carbohydrates serve as diluents for the mineral elements. But the ratio between the cation and anion summation values is not materially affected by the environment.

Considered in relation to the needs of animals and man, two points should be emphasized. First, by using excessive amounts of potassium fertilizers the potassium content of plants can be raised to such levels as to materially reduce their calcium, magnesium, and sodium contents. This is contrary to the best interests of the consumers of these plants since, from the quantitative point of view, calcium is much more important than potassium to animals. Secondly, in proportion as acre yields are stepped up through the production of more carbohydrates, as in the case of hybrid corn, the percentages of all the minerals in plants are lowered.

Potassium is known to be of value in the animal body, but an excess should be avoided. One of the serious diseases of cattle in the low-rainfall regions, in which wheat is pastured during the fall and spring months, is grass-tetany. The potassium content of the pastured wheat plants sometimes reaches as much as 5% of their dry weight. As a result, the amounts of calcium and magnesium in these plants are greatly reduced. The imbalance between potassium and calcium interferes with the normal rhythm of the heart. Similarly, a lack of balance between calcium and magnesium affects muscular activity. Grass-tetany is relieved by an injection of calcium gluconate. The same remedy is applied in cases of milk fever, and possibly for the same reason. The magnesium content of the blood of these animals is

TABLE II.—ASH AND MINERAL-NUTRIENT CONTENT OF RUTGERS TOMATOES FROM 10 STATES *

Ash and P in percentages dry matter, cations in milliequivalents per 100 grams dry matter, other elements in parts-per-million dry matter

State	Ash	P	Cations				Minor Elements					
			Ca	Mg	K	Na	B	Mn	Fe	Mo	Cu	Co
	%	%	*me.*	*me.*	*me.*	*me.*	*ppm.*	*ppm.*	*ppm.*	*ppm.*	*ppm.*	*ppm.*
Georgia	7.78	0.25	6	33	86	3	8	6	107	0.1	10	0.03
S. Carolina	8.20	0.27	8	30	86	4	10	4	119	0.1	11	0.06
Virginia	8.44	0.27	7	34	97	2	7	3	59	0.2	21	0.01
Maryland	7.00	0.19	14	15	88	1	10	5	97	0.1	16	0.04
New Jersey	8.14	0.24	13	21	83	2	9.	7	113	0.2	20	0.08
New York (L. I.)	8.95	0.23	15	17	107	1	11	2	87	0.1	26	0.04
Ohio	9.10	0.27	14	26	102	1	20	3	96	0.3	12	0.02
Indiana	9.18	0.29	15	28	102	2	12	4	52	0.5	14	0.06
Illinois	8.59	0.30	14	28	96	1	12	2	179	2.0	27	0.03
Colorado	11.54	0.25	15	34	111	1	13	1	265	0.5	24	0.11
Lowest	6.07	0.16	5	5	59	0	5	1	1	0.0	0	0.00
Highest	14.20	0.35	23	59	148	7	36	68	1938#	2.0	53	0.63

*Averages of 5 samples per state. # Omitted from average.

TABLE III.—CATION AND ANION VALUES AND RATIOS * IN RANGER ALFALFA IN RELATION TO CHANGES IN K CONTENT OF NUTRIENT SOLUTIONS USED

K Supplied	Yield Dry Wt.	Cations in Entire Crop				Anions in Entire Crop				Cation-Anion
		Ca	Mg	K	Total	N	P	S	Total	
ppm.	*gms.*	*me.*	*me.*	*me.*	*me.*	*me.*	*me.*	*me.*	*me.*	*Ratio*
5.0	10.7	114	33	18	165	261	25	23	309	0.54
19.5	15.0	102	30	34	166	260	22	20	302	0.55
39.0	15.7	76	27	49	152	257	19	18	294	0.52
97.5	16.0	64	21	71	156	270	18	18	306	0.51
195.0	16.5	59	18	89	163	273	16	18	307	0.53

* Cation and anion values are expressed as me. per 100 grams dry matter.

often very low, and that element can also be supplied to advantage in such cases.

As the nitrogen content of plants increases, the percentages of phosphorus and sulfur in them tend to decrease. When nitrate nitrogen is present in excess in the soil, it tends to replace the other anions in plants. This may result in an accumulation of free nitrate, such as is noted in grass-tetany. Vegetables, notably beet leaves and spinach, may contain large amounts of nitrate, which may well have bad effects on their consumers.

The presence of large amounts of chlorine in the soil may result in lowering the value of plants. A good example of this is found in the production of fine-quality cigarette tobaccos that are grown under conditions of nitrogen deficiency. In such cases, it is desirable that the chlorine content of the fertilizer be kept below 2%.

In reports on the analysis of the earth, only 15 elements are usually mentioned, but these constitute 99.25% of it. In many cases, however, the limiting factor in plant and animal well-being is the lack of one or another or of several of the more than 80 other elements that make up the remaining ¾%. This fraction of a per cent contains a considerable number of what are known as minor or trace elements. Some of these are essential only to plants and some only to animals. Others are needed by both plants and animals.

The soils of some regions are naturally deficient in one or more of these elements. Early in the history of this country, widespread development of goiter in man and frequent birth of hairless animals in the Great Lakes region were found to be due to a lack of iodine. This situation is now being remedied by the use of iodized salt. More recently boron deficiency in plants has been found over large areas and considerable tonnages of borax are now being used for fertilizer purposes. So far as is known, iodine is not essential to plants nor boron to animals.

Much more attention is being paid to minor elements now than formerly because of widespread deficiencies. Some of these deficiencies are a result of serious soil erosion, with consequent loss of organic matter. Others are due to losses of the elements by way of the harvested crops during many years of farming. The substitution of the tractor for the horse has added to the difficulty, since this often means more acres under cultivation and less manure for use on the land. Higher acre yields, obtained by planting hybrid seed and using larger amounts of NPK fertilizers, have increased the need for these elements in the soil. And the ever greater purification of materials that go into the manufacture of fertilizers has added the final touch to the trouble.

Minor elements may be considered from two points of view. One is as to their specific need by plants. The other is in relation to their being accumu-

lated by plants in sufficient quantities to meet the needs of animals and man. Those that are known to be essential to plants only are boron and molybdenum. Copper, manganese, and zinc are required by both plants and animals. Cobalt and iodine appear to be needed only by animals.

Boron deficiency in plants is evidenced by such abnormalities as brown discoloration in cauliflower heads, cracked stems in celery, black spots on beet and radish roots, water-soaked areas in the flesh of turnips, corky areas in apples, and dwarfing and yellowing of alfalfa.

Molybdenum is the latest minor element to be added to the list of those that are known to be required by plants. This element operates as a catalyst in an enzyme system that reduces atmospheric nitrogen to ammonia, the first step in protein production. It is also essential to non-legumes to reduce nitrate nitrogen to ammonia. The worst cases of molybdenum deficiency in non-legumes are found in such plants as cabbage and cauliflower. Recently a New Jersey vegetable grower plowed under 40 acres of cauliflower that was so deficient in this element that only a few saleable heads were produced.

Fertile soils contain between 0.1 to 0.3 ppm. total molybdenum, of which only a mere trace is soluble in water. The need for molybdenum for alfalfa is met at 1 part of the element per *billion* of culture solution. The amount required to be applied under conditions of deficiency in the field is of the order of 1 ounce molybdic oxide an acre. This may be added either directly to the seed or to the soil. Field tests with alfalfa in New Jersey, in which sodium molybdate was applied at the rate of 1 pound an acre, resulted in yield increases averaging a little over 13%.

Molybdenum is of special interest as a possible toxic agent in livestock production. Most forage contains 1 or 2 ppm. of this element, on the dry-weight basis. But pastures are known in which the molybdenum content is 20 ppm. or more. On such pastures, the disease known as "teartness" develops. The affected animals develop severe scours, their coats become rough, they lose weight, and, unless the situation is corrected, they die. The remedy is copper sulfate, fed at the rate of 2 grams daily for mature stock. The copper apparently serves as an oxidizing catalyst, thereby nullifying the reducing action of molybdenum.

One of the most easily recognized copper-deficiency symptoms in plants is dieback in citrus, characterized by the death of new growth and formation of axillary branches below the dead portions. Gum pockets develop between the bark and the wood. The fruit is light-colored and shows brown excrescencies. Tomatoes growing on copper-deficient peat soils frequently are dwarfed, the edges of the leaves roll inward, and the plants have a bluish-green appearance. In onions, copper-deficiency is evidenced by a lack of solidity and a pale yellow color of the bulbs.

Manganese deficiency in plants is indicated by dark green veins of the new leaves, with fading of the interveinal tissues. The most common cases of manganese deficiency are on vegetables that are under intensive production, notably in connection with heavy applications of liming materials.

The most notable examples of zinc deficiency in plants are found on pecan and tung trees. The first sign is usually a mottling of the leaves, development of rosettes of small stiff twigs and leaves, and dying-back of the terminal growth. White bud of corn, narrow crinkled leaves on peach trees, pointed fruits on apple trees, and firing of the tips of wheat and barley plants are other symptoms.

Copper, manganese, and zinc are known to be essential also to animals. But any lack of these elements in the soil is likely to result in deficiency symptoms on the plants growing on it.

(*Turn to page* 45)

Fig. 1. Checking in and drying soil samples in a soil testing laboratory.

Use of a Soil Test Summary in Agronomic Programs

By C. D. Welch

Soil Testing Division, North Carolina Department of Agriculture, Raleigh, North Carolina

IT is recognized that the primary purpose of soil testing is to give the individual farmer dependable information as to the fertility status of each field on his farm. However, a summary of soil test data on a county, type of farming area, or a state basis shows general fertility levels.[1] This information is of value to agricultural workers, especially agronomists.

The objective of this paper is to point out applications that can be made of a soil test summary similar to that published by the Soil Testing Division, N. C. Department of Agriculture in July 1951.[2]

Source of Data and Procedure

The summary mentioned above reports the results of soil tests made during the period from July 1, 1949, to June 30, 1950. The data were first

[1] Parker F. W., Nelson, W. L., Winters, Eric and Miles, I. E. The broad interpretation and application of soil test information. Agronomy Journal, 43:105-112. 1951.

[2] Welch, C. D. and Nelson, W. L. Fertility Status of North Carolina Soils. N. C. Department of Agriculture, July 1951.

summarized on a county basis, and the percentages of the samples tested falling in each of five groups—VL, L, M, H, and VH in calcium, phosphorus, and potassium—were calculated.[3] The percentages of soils in five ranges of pH (below pH 5.0, pH 5.0 to 5.5, pH 5.6 to 6.0, pH 6.1 to 6.5, and above pH 6.5) and five ranges of organic matter (less than 1.0%, 1.0 to 1.5%, 1.51 to 2.0%, 2.01 to 2.5%, and above 2.5%) were also calculated.

The above percentages were also calculated in relation to the crop to be grown (crop for which recommendations were made). This was done in each county, on the four crops which had the largest number of recommendations. These data, as related to crops, were then combined by type of farming areas and on an over-all state basis. The amounts of lime recommended were included for the various crops.

In order to construct state maps showing fertility levels, it was necessary to obtain a weighted average or a single index for each county.[1] This was obtained by multiplying the percentage of samples in the VL group by 1, in the L group by 2, in the M group by 3, in the H group by 4, and in the VH group by 5. The sum of these products was divided by 100 to give the index. The counties were listed in order from low to high index for each test, divided into four equal groups, and each group given a different shading on the maps.

Copies of the summary were sent to local agricultural agencies including county agents, vocational agricultural teachers, and soil conservationists. Additional distribution included these agencies and PMA at the state level, members of the fertilizer industry operating in the state, and other interested persons.

Sample bias, that is, the failure of the samples to represent average fertility conditions in the county, must be considered. For example, the more progressive farmers may be taking advantage of soil tests. These farmers may be using more lime and fertilizer resulting in soils that are at a higher fertility level than the average of a county or a state. A study is now underway to provide information on this problem.

General Fertility Levels

Lime: The data emphasize the general acid condition of the soils in North Carolina. The Coastal Plain counties have the lowest acidity index (Figure 2). Lime usage helps to explain some of the acidity difference between areas in the State and is related to crop distribution.[4] Little, if any, lime is used for tobacco, which is grown extensively in the Coastal Plain and northern Piedmont regions. On the other hand, rather heavy application may be made for forage and hay crops which occupy a relatively large portion of the crop land in the Mountains and parts of the Piedmont. In addition the soils in the Coastal Plain are more sandy and, hence, more highly leached than the soils in the Piedmont and Mountains.

The acid condition of soils on which most crops are being grown in North Carolina is further emphasized by data in Table I. It can be readily seen that a high percentage of the soils analyzed has a pH 5.5 or below. This is too acid for most crops to produce maximum yields. However, it should be stressed that both crops and soils vary in their lime requirements. For example, low rates of lime are needed for tobacco. On the other hand, ladino clover generally requires a relatively high pH but may grow well on organic or clay soils (high exchange capacity) at a relatively low pH, while a higher pH may be necessary on sandy soils (low exchange capacity) in order to

[3] Acknowledgment is made to the Department of Experimental Statistics, North Carolina State College for IBM Card analyses.

[4] Correlation coefficients on a county basis:
Soil acidity x lime usage $r = .57^{**}$
Soil phosphorus test x fertilizer usage $r = .78^{**}$
Soil potassium test x fertilizer usage $r = -.50^{**}$

Fig. 2. pH in soils of North Carolina counties. Soils throughout the State are generally acid, with those in the lower Coastal Plain being most acid.

supply sufficient calcium.

When compared with the North or Midwest, most soils in North Carolina have a relatively low lime requirement. On extremely sandy soils, frequent small applications may be needed to maintain an adequate supply of calcium and magnesium for good crop growth, while heavier, less frequent applications may be satisfactory on the heavier textured soils.

Phosphorus: The soil phosphorus level varies greatly between counties and those having the highest phosphorus levels are in the Coastal Plain (Figure 3). These variations have been brought about primarily by differences in past fertilization practices, as most of the virgin soils in North Carolina are extremely low in available phosphorus. When cropping begins, the level of soil phosphorus gradually increases since much more phosphorus is added in fertilizers than is removed by crops or lost by leaching, erosion, and fixation.

Calculations have shown that fertilizers used in North Carolina supply an average of more than five times as much P_2O_5 as is removed in harvested

TABLE I.—ACIDITY (pH) AS RELATED TO CROPS (AVERAGE OF RESULTS FROM ALL SAMPLES TESTED FOR EACH CROP)

Crop to be grown	No. of samples tested	Percentage of samples testing				
		Below 5.0	5.0–5.5	5.6–6.0	6.1–6.5	Above 6.5
Tobacco (Flue-cured)	11,868	7	46	38	8	1
Tobacco (Burley)	219	1	19	28	30	22
Cotton	2,165	4	39	42	13	2
Corn	7,351	9	39	33	14	5
Peanuts	1,660	3	28	43	23	3
Soybeans	433	22	33	29	13	3
Ladino-grass	4,274	16	43	25	12	4
Other pastures	648	4	35	35	19	7
Alfalfa	1,693	4	28	26	28	14
Irish potatoes	291	53	34	9	4	0
Sweet potatoes	83	23	53	22	2	0
Other truck crops	805	18	34	31	12	5

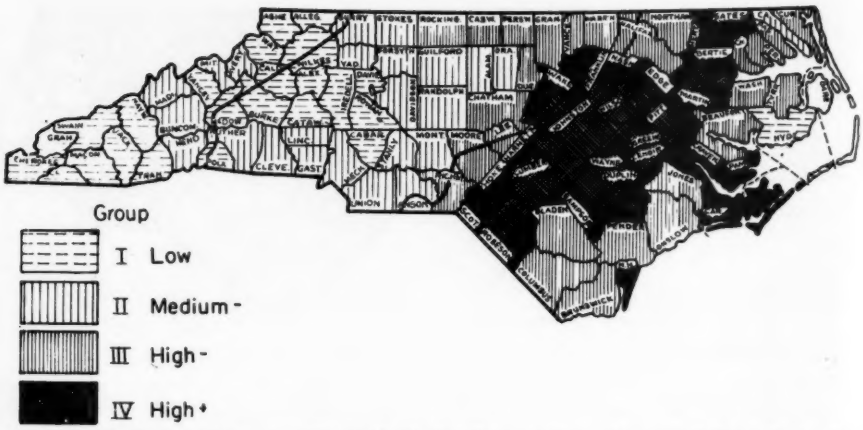


Fig. 3. Available phosphorus in soils of North Carolina counties. In general the soils in the Coastal Plain counties have a higher phosphorus level than those in the Piedmont and Mountain counties.

crops.[5] Hence, a rather close correlation between soil phosphorus and fertilizer consumption might be expected.[4] In this latter comparison, it was necessary to employ the data for average total fertilizer used per acre since the data for P_2O_5 applications were not available.

The fertilizer usage and phosphorus levels can be rather generally related to the distribution of the acreage of tobacco and cotton. There is a considerable amount of tobacco in the northern Piedmont and Upper and Middle Coastal Plain, while the cotton acreage is highest in the Upper Coastal Plain and in the southern Piedmont.

Potassium: In contrast to phosphorus, the potassium content of the soils is lowest in the Coastal Plain counties (Figure 4). These soils have a low native supply of available potassium. On the other hand, many of the parent rocks of the Piedmont and Mountain soils are high in potassium-bearing minerals. Hence, the virgin soils in the latter areas may be rather well supplied with potassium.

There is an inverse relationship be-

[5] Mehring, A. L. and Parks, R. Q. How nutrients removed from the soil by harvested crops are replaced by fertilizers. Agri. Chem., Oct. and Nov., 1949.

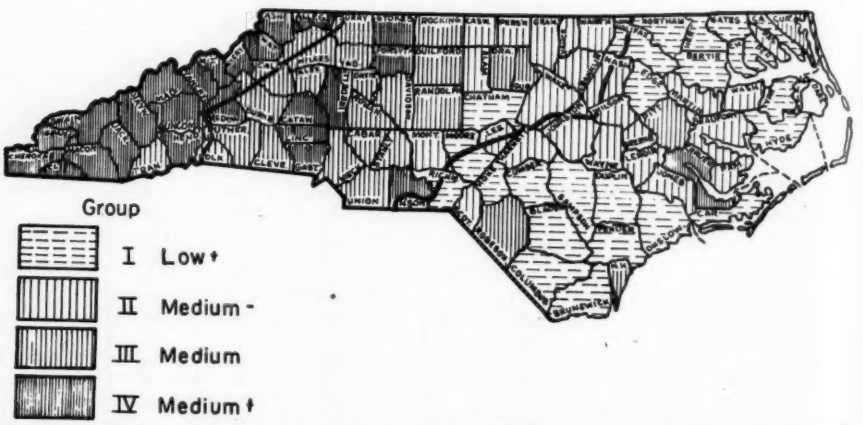


Fig. 4. Available potassium in soils of North Carolina counties. In general soils in the Coastal Plain counties are lower in potassium than in the Piedmont and Mountain.

TABLE II.—PERCENTAGES OF SAMPLES IN EACH pH, PLANT FOOD AND ORGANIC MATTER CLASSIFICATION FOR THE COUNTY AS A WHOLE AND FOR CROPS IN THE COUNTY

A. Soil Analyses for County*

pH		Plant Food				Organic Matter	
Range	%	Levels	Ca %	P %	K %	Range	%
Below 5.0	19	VL	14	5	12	Below 1%	59
5.0–5.5	48	L	31	11	55	1.0–1.5	15
5.6–6.0	29	M	51	10	19	1.51–2.0	9
6.1–6.5	4	H	4	20	5	2.01–2.5	10
Above 6.5	0	VH	0	54	8	Above 2.5	7

B. Soil Analyses As Related to Crops in County

pH		Plant Food				Organic Matter		Lime Recom.	
Range	%	Levels	Ca %	P %	K %	Range	%	Rate	%
Tobacco (424 Samples)									
Below 5.0	10	VL	13	0	6	Below 1%	36	None	83
5.0–5.5	53	L	30	6	61	1.0–1.5	34	500–1500	16
5.6–6.0	33	M	55	8	23	1.51–2.0	17	2000	0
6.1–6.5	4	H	1	20	4	2.01–2.5	7	3000	0
Above 6.5	0	VH	0	65	7	Above 2.5	5	4000 or more	0
Ladino-grass (129 Samples)									
Below 5.0	43	VL	26	19	31	Below 1%	8	None	12
5.0–5.5	46	L	23	30	46	1.0–1.5	20	500–1500	0
5.6–6.0	8	M	40	14	15	1.51–2.0	33	2000	10
6.1–6.5	2	H	10	19	3	2.01–2.5	19	3000	21
Above 6.5	0	VH	0	19	4	Above 2.5	20	4000 or more	56
Corn (113 Samples)									
Below 5.0	15	VL	12	2	17	Below 1%	30	None	35
5.0–5.5	53	L	37	8	56	1.0–1.5	38	500–1500	35
5.6–6.0	28	M	50	11	14	1.51–2.0	12	2000	26
6.1–6.5	3	H	0	25	2	2.01–2.5	4	3000	3
Above 6.5	0	VH	0	54	11	Above 2.5	15	4000 or more	1
Cotton (22 Samples)									
Below 5.0	14	VL	0	0	5	Below 1%	68	None	45
5.0–5.5	54	L	55	0	59	1.0–1.5	23	500–1500	50
5.6–6.0	32	M	45	14	9	1.51–2.0	9	2000	5
6.1–6.5	0	H	0	18	18	2.01–2.5	0	3000	0
Above 6.5	0	VH	0	68	9	Above 2.5	0	4000 or more	0

* Duplin County (809 Soil Samples).

tween the potassium content of the soils and amount of fertilizer used.[4] This apparent discrepancy exists because the most heavily fertilized crops are grown in the Upper and the Middle Coastal Plain regions where the soils were originally low in potassium. Calculations show that fertilizer supplied 158% as much potash as was removed by harvested crops in North Carolina.[5] Allowing for losses due to leaching, erosion, and fixation, any increases in potassium levels in the soil due to fertilization would be relatively small.

On a broad basis, the content of potassium in soils is more closely related to soil associations than to fertilization. It is realized, however, that on a given soil, continued heavy fertilization will build up the potassium level. This has been demonstrated in the Irish-potato-producing sections where one ton of fertilizer per acre is applied year after year on the same field.

The above information gives a general picture as to the fertility status of the soils throughout the State with respect to lime, phosphorus, and potassium. This represents the condition existing during the sampling period and would be expected to change due to liming, fertilization, and other production practices.

Special Uses of Summary

A soil test summary furnishes specific information that can be used by local agricultural leaders, extension specialists, fertilizer industry agronomists, and experiment station agronomists.

Local agricultural leaders: An example of the data for a county is presented in Table II. The top section (A) gives the average of results for all samples received from the county. This shows the general soil condition with respect to pH, calcium, phosphorus, potassium, and organic matter. Below is similar information along with the amounts of lime recommended on four crops in the county. This gives an indication of the fertility levels of soils on which various crops are being grown. It can be readily seen that pasture fields in this county are more acid and less fertile than many row crop fields. This emphasizes the importance of proper liming and fertilization in establishing productive pastures.

The data in Table II also show that most of the samples for tobacco recommendations were high in phosphorus and low in potash. Information such as this is being used by local agricultural leaders and extension tobacco specialists as one means of showing farmers that 4-8-10 and 8-0-24 are fertilizers that are more nearly in line with soil and plant requirements than grades such as 3-9-6 and 5-5-20 which have been used extensively for tobacco.

Extension specialists: Agronomy extension specialists can obtain information as to the fertility level of soils on which various crops are being grown in a county or type of farming area. North Carolina is divided into 12 types of farming areas. Figure 5 shows a method of presenting data on ladino clover-grass pasture samples for pH, phosphorus, and potassium for one of these areas. Slides made from these charts are being used in showing farmers the general fertility level of soils being used for crops. Attention is directed toward special fertilization where needed and the importance of each farmer knowing his soil. Local information helps to create a greater interest in soil testing and recommendations. However, it is being stressed that the only way to determine if a field needs lime or is low in phosphorus or potassium is to have a soil test made.

Many other examples, useful in an educational program, can be taken from this summary.

Industry agronomists: Fertilizer and lime industry agronomists can use soil test summaries in predicting what analysis fertilizer will be most recommended for specific crops in each area or county and where lime is most

(*Turn to page* 39)

Tomato Production for the Canning Industry

By Jackson B. Hester

Department of Agricultural Research, Campbell Soup Co., Riverton, New Jersey

THE well-being of an agricultural people is dependent upon their ability to produce efficiently, economically, and deliver their crops at the most advantageous time. Vegetable crop production in the State of New Jersey has been efficient and economical in the past and thereby has brought to its people more than 10 millions of dollars per year and, to the United States as a whole, astounding figures.

It might be stated, however, that all growers are not producing as efficiently and satisfactorily as they could be. A number of growers have produced well above 10 tons of tomatoes per acre annually. Many growers have actually exceeded the 20-ton goal. In fact, several growers produced more than 20 tons of tomatoes per acre in the State of New Jersey last year. It therefore behooves all of us concerned with this problem to analyze projectively the potential possibility on each farm.

During the development of research and agricultural pursuits, the idea has been evolved to eliminate one by one the limiting factors in crop production. These limiting factors, of course, vary from farm to farm and from field to field. First, it might be interesting to list some of the limiting factors that are within the control of the individual concerned:

1. Soil reaction, pH value or lime status of the soil including the calcium and magnesium supply.
2. Erosion and leaching.
3. Amount of fertilizer necessary.

Fig. 1. Properly limed soil.

Fig. 2. Severe water erosion.

4. Method of application of fertilizer.
5. Inclusion of secondary elements in the fertilizer mixtures.
6. Procurement and use of good plants.
7. Proper methods of transplanting with starter solution.
8. Proper method of cultivation.
9. Proper methods of insect and disease control.
10. Picking and delivering.

Certainly all of these 10 listed fac-

tors are within the control of the growers concerned. It is probably worth analyzing each separately.

Soil Reaction

Adequate facilities are available for analyzing the soil for soil reaction and calcium and magnesium supply and to furnish the information necessary to correct this condition. A soil reaction between pH 6.2 and 6.8 is ideal for the production of tomatoes. If the soil reaction is corrected to this pH with calcium and magnesium limestone or other liming materials, there will be an adequate supply of calcium and magnesium except under cases of extremely heavy rainfall or adverse growing conditions.

Erosion and Leaching

Two problems of prime importance in economic crop production are (1) wind and water erosion and (2) leaching. The extent of water erosion is primarily dependent upon the texture of the soil, the degree of slope, and rainfall. This can be minimized by terracing, strip cropping, and crop rotation practices. Wind erosion can be minimized by keeping a crop growing on the soil as continuously as possible. When nothing is growing on the soil to absorb the plant nutrients, water passes through the soil freely and the available plant nutrients are leached out of the soil. The most logical way to prevent this is by having something growing on the soil to absorb the available plant nutrients. The most satisfactory protective crops during the winter season are rye grass, rye, vetch, and other grain crops in at least the Northeastern and Southern sections.

Fig. 3. Right—plat planted to rye and vetch over the winter; left—plat left bare and subject to leaching and wind and water erosion.

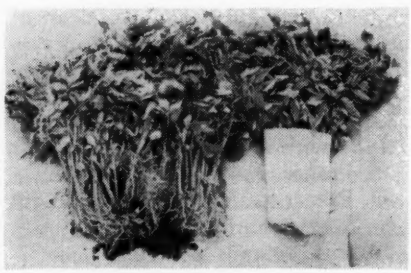


Fig. 4. Satisfactory plants.

Fertilizer

Almost continuously during the past 15 years experimental plantings with 500-lb. increments of fertilizer up to 3,000 lbs. per acre have been under investigation on various types of soil and in different locations. The conclusion can be drawn that 1,500–2,000 pounds of fertilizer properly applied in respect to climate and soil type are about the maximum amount that can be economically used.

On sandy soils, fertilizer should be used as three successive sidedressings or 500 lbs. in the row before planting and applying the remainder as two sidedressings. On heavier types of soil a portion (approximately one-half) of the fertilizer may be broadcast previous to planting and the remainder placed in the row or in bands close to the plant, or used as a sidedressing.

Recently, split applications of fertilizer have received considerable attention. High phosphatic fertilizers are being used in the early application and muriate of potash, anhydrous ammonia, ammonium nitrate, urea, or other sources of nitrogen are being used as sidedressings very effectively. On the sandy soils the use of various sources of nitrogen and potash as a sidedressing eliminates the possibility of leach-

ing. On the heavier types of soil it has been observed that the application of potassic salts as a sidedressing tends to eliminate the potential possible fixation of potassium in a relatively unavailable state. At the outset it has been established that the use of 1,500-2,000 lbs. of fertilizer carrying approximately 100 lbs. of nitrogen and 200 lbs. of potash is economically feasible in tomato production but the application of this material, along with adequate phosphorus, is dependent primarily upon climatic conditions and soil types.

Boron is a limiting factor in many soils. Each acre of tomatoes may be benefited by 10 lbs. of borax per year. By and large, this will offset any boron deficiency that is likely to occur. Borax may be mixed with the fertilizer or applied broadcast previous to planting. It can be used in the spray but only 3-4 lbs. in 100 gallons of water.

The copper and zinc are usually supplied in the spray materials in sufficient quantities to take care of deficiency.

Magnesium can be supplied from water-soluble magnesium compounds at the rate of 20-40 lbs. of magnesium oxide per acre if it becomes evident during the growing season that magnesium is the limiting factor. It has been observed that even on soils that have been limed with magnesium limestone, under severe leaching conditions, magnesium deficiency has occurred. Spray applications of magnesium and borax are effective in offsetting deficiency conditions.

Plants

It is essential that good plants be procured early for maximum crop production. The plant industry developed in Georgia, by and large, supplies excellent plants. Good uniform plants similar to those shown in Fig. 4 are desirable. The grower must use good judgment in holding and transplanting these plants.

Three to five pounds per 100 gallons of water of a good plant starter mixture analyzing 15-30-15 or similar analyses should be used in transplanting. The plants should be set deeply and the packing wheels or shoes so adjusted as to establish a firm compactness around the plant roots. Oftentimes the shoes are so set as to firm the soil around the stem of the plant but not around the roots, leaving the roots suspended in air.

Fig. 5. Starter solution on left; no starter solution on right.

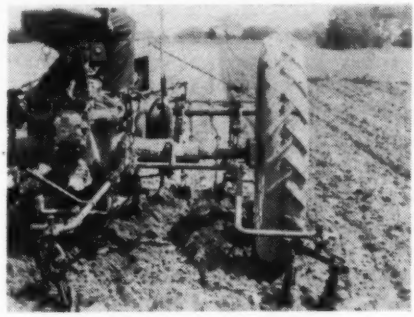


Fig. 6. Tractor cultivation.

Cultivation

Probably more fields of tomatoes do not produce the maximum yield because of improper cultivation than any other single factor. Cultivation is performed for three distinct reasons, namely, to control weeds and grass, to introduce oxygen from the air into the soil, and to prevent erosion and leaching. This has to be accomplished, of course, without injury to the root system of the plants. Poor cultivation results when the shoes are not properly set and the root system is destroyed. Many types of cultivator shoes, teeth, sweeps,

(*Turn to page* 44)

No More Fodder Pullin'

By J. S. Buie

Soil Conservation Service, Spartanburg, South Carolina

THE sight of naked green cornstalks standing in the fields during the late summer months used to cause travelers through the deep South to wonder what had happened. Had a terriffic hailstorm or other calamity stripped all the leaves from the stalks?

To local people, such a question was a gross display of ignorance. Everybody should know that "fodder pullin'" was just as necessary as picking cotton, cutting oats, or gathering corn after the first frost had killed most of the weevils.

For generations, Southern farmers stripped the green blades from their cornstalks for "fodder" to feed their work stock. But today, fodder pulling is a rare sight, because as we'll tell you later, new hay and grazing crops and modern machinery are changing Southern agriculture.

Experiment stations long before had proved through numerous carefully planned tests that the loss of grain due to stripping the still green leaves from the corn before the grains were fully mature more than offset the value of the forage. But results of these tests had little influence on the man who needed feed for his mule.

Fodder was considered the "strongest" roughage a mule could eat. If the supply began to run short, the bundles of fodder were carefully husbanded against the time early the next summer, when the pressure would be hardest—when men and mules had to go from "kin to kaint" or dawn to dusk, to keep ahead of the grass. None of it was ever wasted on cows—not even on the milk cow, unless she was puny and off her feed when, very grudgingly, a bundle or two might be given her.

On the typical farm of the Southeast in former generations, farmers maintained a rigid planting schedule in which both the season and cultural customs played a part. After corn and cotton were planted in the spring, there was a short lull—a period of visiting, fishing, and so on—before the oats had to be cut. By the time the oat stubble was plowed and peas planted for a hay crop, one middle of the cotton and corn had to be plowed every week, and the middles "busted out," or the grass would take over.

There were two possible periods for holding the Big Meeting, that religious-social occasion which marked the time for visiting and other recreations. One was just after the cotton was laid by and before time to pull fodder. The other was between fodder pulling and cotton picking time. "Fodder pullin' time" was an occasion second in importance only to "cotton pickin' time."

The drudgery of pulling fodder was lessened by certain desirable features. To begin with, it could not be started too early in the morning, as the fodder pullers had to wait for the heaviest of the dew to dry. Then the whole group could work together, talking or singing, as with deft downward strokes of both hands the blades were stripped from the tall stalks.

A handful of leaves bound together with two or three blades was called a "hand." This bundle of leaves was hooked over a broken stalk or between the ear and stalk to dry.

One of the greatest compensations when pulling fodder was to find a volunteer watermelon vine with one

Fig. 1. Blades are deftly stripped from the stalk.

or two melons on it. Anyone who ever pulled fodder will insist that there never was a more delicious morsel than such a melon "busted" over a stump and the firm red flesh gouged out by hands grimy with the sweat of honest labor.

Then, at the end of the long rows, time would be taken out to go to the spring at the lower side of the field for a cool drink of water. No beverage was ever more delicious than the spring water dipped in a gourd or quaffed while on all fours, with one eye on the green frog which balefully blinked from the other side of the spring.

After a day or two of drying, the fodder had to be "taken up" and hauled to the barn. Three or four of the "hands" were bound together with several leaves of one of the "hands" to form a tight bundle which could withstand rough handling.

This "taking up" could be done only after the dew had fallen in the dusk of early evening when the individual blades were pliable and would not break. There was much hurrying around when a cloud would come up just as most of the fodder was being carried to the end of the row. Rain would do but little harm while fodder was still hanging in hands on the stalks, but if the bundles got wet they might be ruined.

A good strong man could carry a score or more of bundles by grasping two or three blades of each. As he walked across the field—totally obscured by brown bundles of fodder around him and over him—he bore a striking resemblance in the dim twilight or moonlight to an animated haystack.

But today, except in a few remote localities in the Southeast, fodder pulling has vanished from the farm scene. In fact, it took an appeal on farm programs of two radio stations covering a large farming area to find a place where the accompanying pictures could be taken. One lone farmer called in to say he was planning to pull some fodder in a few days, if the photographer wanted to come out and get some pictures.

What clear-cut experimental results failed to accomplish in discouraging fodder pulling was finally brought about by revolutionary changes in the whole farming system in the Southeast. As long as farmers had mules to feed and nothing better than fodder to feed

(*Turn to page* 43)

Soybeans Need Fertilizer On Many Arkansas Rice Farms

By R. L. Beacher and E. M. Cralley

Departments of Agronomy and Plant Pathology, Agricultural Experiment Station, Fayetteville, Arkansas

SOYBEAN chlorosis has been observed for a number of years in several of the rice-growing areas of Arkansas.* The disease was first observed in fields where soybeans followed rice in the rotation system and was most conspicuous in narrow bands in the fields which coincided with the location of the leveled rice levees. The disease has gradually increased in importance to the point where large acreages are involved and 75% of the plants in certain fields show chlorotic symptoms.

The soils in these regions were generally known to be low in phosphorus and potash. Soil tests from typical old rice fields often showed topsoils to contain less than 10 ppm. of available phosphorus (Bray) and only 20 ppm. of available potassium (Morgan extract). Recently summarized soil test data, representing 22,000 acres on 600 rice farms in the region, indicated that 85% of the tested acreage contained less than 20 ppm. available phosphorus and 88% contained less than 50 ppm. available potassium.

The more serious cases of soybean chlorosis were often noted on soils which had an alkaline reaction (pH 7.5 to 8.2) in conjunction with low phosphate and potash levels. Many rice fields, though originally strongly acid, become increasingly alkaline after repeated irrigations with well water which is quite high in lime. In several instances soil samples were collected from closely adjoining areas with chlorotic and normal plants within the same field, and test results consistently indicated that a direct or induced potassium deficiency was a primary cause of the chlorotic condition.

On one particular field, "disease" symptoms were noticeably more severe on soybeans in narrow bands across the field; the bands coincided with the location of rice levees the previous year. A composite soil sample was collected within these narrow bands and another from spots just a few feet on either side of the bands where symptoms were less severe. Both samples contained identically low amounts of organic matter, available phosphorus, and available potassium, but the sample from the severely diseased band had a pH of 7.8 and the other a pH of 7.1. The more alkaline reaction of the soil on the old levee bands may be explained by the tendency for calcium to accumulate as the rice irrigation water (high in lime) evaporates through the exposed top and sides of the levee. It is conceivable that the higher alkalinity of the soil in these old levee bands may have resulted in decreased plant absorption of potassium and phosphorus. Results of tissue tests supported the soil test indications.

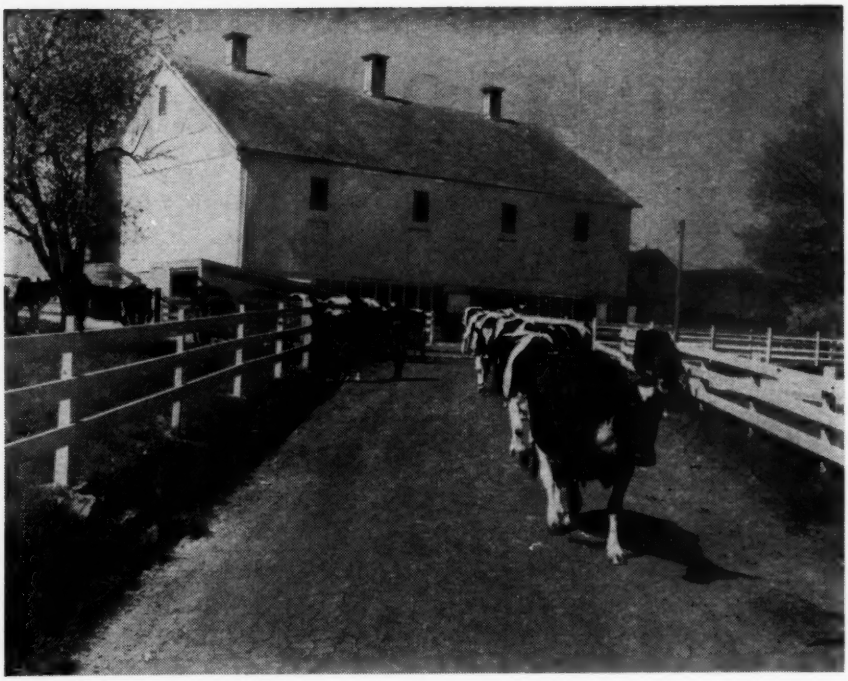
As a result of the soil tests, and since the chlorotic symptoms resembled potassium deficiency, five fertilizer tests were conducted in 1950 using potas-

(*Turn to page* 41)

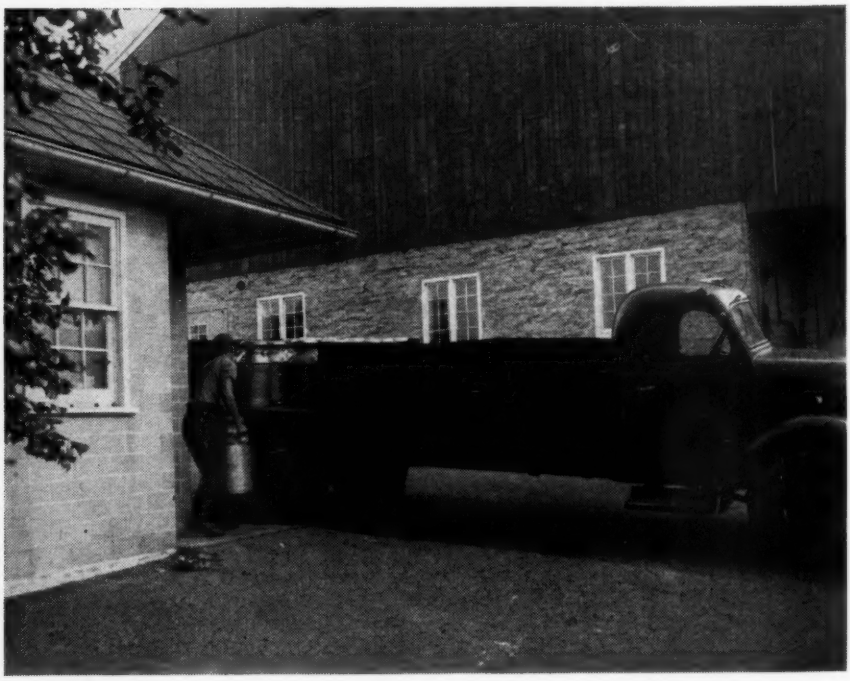
* Cralley, E. M. and Beacher, R. L. The control of soybean chlorosis in the rice-growing areas of Arkansas by potassium applications. Phytopath. 41: 1 abst., 1951.

PICTORIAL

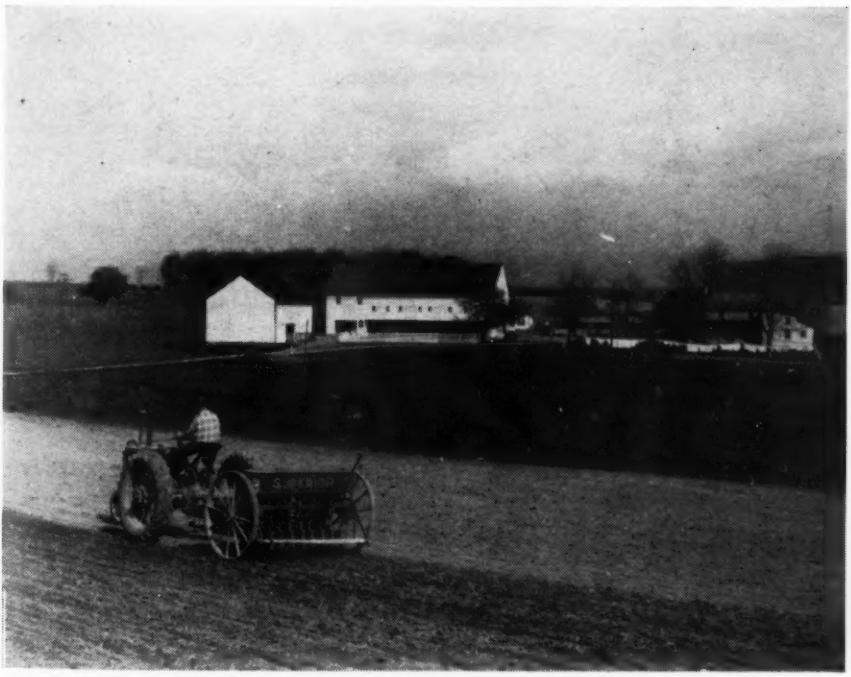
Pleasant Memories



Operation Milk Production



Operation Crop Production



Above: Cultivating a California vineyard.

Below: Preparing for a crop of hops.

The Editors Talk

Soil Bank According to Emil Truog, Soil Scientist of the University of Wisconsin, the soil can be likened to a dependable banker. Nutrient deposits in the bank (except nitrates) are safe against leaching and loss, but are available to the checks written against them by the roots of plants. This service is performed by what Truog calls the miracle mineral, particles of which are so fine that 10,000 of them could be laid side by side in the space of 1/25 of an inch. These tiny particles, called aluminosilicates, cling to the larger soil particles and the plant nutrients cling to them. Plant roots only can get the nutrients from the miracle mineral, and they must do it by exchanging a less desirable material.

Plant roots that pick up these nutrients are tiny, but numerous. A four-week-old rye plant will have about 6,000 square feet of root surface. These tiny roots coming in contact with these tiny particles make the trades and transactions that let the plant live and thrive.

The soil not only acts as a storage place for fertility deposits, but it also helps a farmer with his management problems, Truog explains. If a small deposit or a light application of nutrients is made, the soil stores it in a form that plants can use easily. It is deposited to the checking account. But if the farmer makes large deposits, the soil will put some of it in "bonds and real estate." Then as the checking account gets smaller, the miracle mineral transfers "funds" from the long-time investments to the checking account. But, like any good banker, the miracle mineral requires that there is a deposit before checks can be written against it.

This may be somewhat of an over-simplification of all the complexities of base exchange and other chemical reactions which take place in the soil. However, it emphasizes the need for an ample supply of plant foods if success with crops is to be attained.

Turning to Grass This is the time of year when grass "looms large in the thoughts of man and animal." Farmers are watching their pastures to determine how soon they can rid themselves of a lot of tiresome barn chores. Animals are gazing wistfully over barnyard fences at the succulent green on which they thrive. Householders are getting out their lawn-mowers and wondering whether they have applied enough

fertilizer to carry their lawns throughout the summer. And our agricultural authorities are insisting that more and more of this nation's acreage be turned to grass.

A billion acres of grazing land in this country may sound like plenty of grass. However, according to Secretary of Agriculture Charles F. Brannan, the majority of these acres are unimproved, and about 90 per cent of the billion, including those that have been worked on, need still further improvement. He tells of land in North Carolina, capable of producing 50 bushels of corn per acre, that produced the equivalent of 87 bushels of corn when it was converted to improved pasture. The same amount of feed nutrients that cost $1.77 in the form of corn was produced from improved pasture for 58 cents. The difference in returns per man-hour of labor was even larger. The return per man-hour for producing corn was $3.69, but for improved pasture the return per man-hour of labor was $23.09.

The Secretary states that in the humid eastern part of the United States there are a quarter of a million acres of grassland, mostly unimproved. If this acreage could be improved and if the 70 million acres of abandoned, idle, and submarginal cropland east of the Mississippi River could also be converted into improved pasture, this eastern area alone could carry 97 million additional animals. And the scientists say that there are greater possibilities for boosting production on grasslands in the South than in any other part of the country.

These are figures to reckon—more return per acre, more return per man-hour of labor, more food at less cost for our increasing demands. Surely the emphasis being put on turning to grass is well justified.

Our Cover Picture

Signs of potash starvation show up quickly on soybean plants. A yellow mottling of the leaves appears first; then the chlorosis forms a continuous band along the sides and tip ends. In advanced stages, the chlorosis extends inward and the margins of the leaves fire to a medium brown color. The centers may still be green after the margins are completely dead. There will be a downward cupping, and after the dead tissue falls out, the leaves will have a ragged appearance. Lack of potash results in wrinkled and misshapen seeds.

The importance of soil and fertilizer supplying enough of this plant food is seen in the rapid rise of soybeans to a place among our major cash crops. A native of eastern Asia where first recorded mention of it appeared more than 5,000 years ago, the soybean was not grown in this country until about 1880. Now, some 15 million acres devoted to its culture will produce in the neighborhood of 300 million bushels of soybeans for the many uses to which they can be put. These uses include edible oils for shortening, margarine, salad dressing, bakery and meat products, and industrial oils for paints, enamels, linoleum, oil cloth, waterproofing, and soapmaking. In addition the beans are made into soybean flour for human consumption and oil meal for animal feed. As a forage crop, soybeans make a good hay; and for a green-manuring crop, they provide a quick means of building up the humus content of soils.

Soybeans are active feeders on potash, a yield of 25 bushels of seed and 1.25 tons of straw utilizing 60 lbs. of K_2O. Potash not only influences total yield but also the quality of the crop, particularly the oil content.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932..	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.6	91.6	173.0	153.0	200.0	16.70	86.50	....
1951									
April.....	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.....	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.....	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.....	39.11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August.....	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	....
September...	33.73	52.4	123.0	287.0	165.0	207.0	16.55	66.10	....
October.....	36.21	57.7	139.0	271.0	164.0	210.0	17.15	69.90	....
November....	41.00	50.0	174.0	280.0	162.0	219.0	18.35	72.70	....
December....	40.34	51.0	193.0	305.0	169.0	222.0	19.65	71.50	....
1952									
January.....	38.70	46.2	207.0	347.0	168.0	220.0	20.75	70.10	....
February....	37.25	33.8	205.0	357.0	166.0	218.0	20.65	67.10	....
March.....	36.72	23.5	216.0	383.0	165.0	220.0	20.35	61.50	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948	245	482	222	253	201	226	155	298	214
1949.....	231	459	184	244	193	213	139	192	201
1950.....	323	516	131	197	238	226	141	384	185
1951									
April.....	348	253	161	231	252	242	155	457	225
May.....	342	398	156	238	255	239	153	448	239
June.....	339	490	155	239	252	235	142	424	189
July.....	315	495	169	249	254	232	130	346	204
August.....	279	477	168	311	257	232	132	306	181
September...	272	524	176	327	257	234	139	293	161
October.....	292	577	188	309	255	238	144	310	171
November...	331	500	250	319	252	248	155	322	249
December....	325	510	277	347	263	251	166	317	331
1952									
January.....	312	462	297	395	262	249	175	311	337
February.....	300	338	294	407	259	247	174	298	217
March.....	296	235	310	436	257	249	171	273	265

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951						
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10.06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66
September	3.13	2.07	11.50	10.78	9.26	9.26
October	3.13	2.07	12.85	11.28	10.56	10.32
November	3.34	2.07	13.93	11.28	10.39	10.25
December	3.34	2.07	14.27	11.28	10.08	10.02
1952						
January	3.34	2.07	14.27	11.28	10.39	12.16
February	3.34	2.07	14.27	11.28	11.61	11.08
March	3.34	2.07	14.26	11.28	9.71	9.04
	Index Numbers (1910-14 = 100)					
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951						
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	246
September	117	73	329	305	275	263
October	117	73	365	320	313	293
November	125	73	398	320	308	291
December	125	73	408	320	299	285
1952						
January	122	73	408	320	308	345
February	125	73	408	320	344	315
March	125	73	407	320	288	257

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951							
April	.810	3.98	5.47	.420	.796	16.00	.210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193
September	.810	3.98	5.47	.386	.768	14.72	.193
October	.820	3.98	5.47	.386	.768	14.72	.193
November	.820	3.98	5.47	.386	.768	14.72	.193
December	.820	3.98	5.47	.420	.827	16.00	.210
1952							
January	.820	3.98	5.47	.420	.827	16.00	210
February	.820	3.98	5.47	.420	.827	16.00	210
March	.832	3.98	5.47	.420	.827	16.00	210
			Index Numbers (1910-14 = 100)				
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951							
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	82
September	151	110	112	70	81	61	82
October	153	110	112	70	81	61	82
November	153	110	112	70	81	61	82
December	153	110	112	75	87	66	85
1952							
January	153	110	112	75	87	66	85
February	153	110	112	75	87	66	85
March	155	110	112	75	87	66	85

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950	256	246	236	132	89	314	142	72
1951								
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78
June	301	272	265	134	91	311	151	69
July	294	271	261	135	93	297	151	74
August	292	271	258	135	94	294	151	74
September	291	271	258	135	94	300	151	73
October	296	272	259	140	94	335	153	73
November	301	274	259	143	98	343	153	73
December	305	273	258	144	98	342	153	78
1952								
January	300	275	258	144	98	347	153	78
February	289	276	255	146	98	365	153	78
March	288	276	251	144	98	336	155	78

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only; manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Sales of Commercial Fertilizers and of Agricultural Minerals Reported to Date for Quarter Ended December 31, 1951," Dept. of Agr., Sacramento, Calif., Bur. of Chem. Announcement No. FM-223, Feb. 18, 1952.

"Commercial Fertilizers Inspected and Analyzed in the State of Georgia, Year 1951," Dept. of Agr., Atlanta, Ga., Serial No. 136, Jan. 1952.

"Nitrogen Use Chart," Ext. Serv., Purdue Univ., Lafayette, Ind., Mimeo AY-74a, Feb. 1952.

"Tonnage of Commercial Fertilizer Reported by Manufacturers as Shipped to Kansas in the Fall of 1951, by Counties," Board of Agr., Control Div., Topeka, Kans., Feb. 25, 1952.

"Maryland Fertilizer Facts for 1951," Inspection and Regulatory Serv., College Park, Md.

"Fertilizer Inspection and Analysis; Spring, 1951," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 564, Dec. 1951.

"Fertilizer Sales by Grades in Order of Tonnage, July 1, 1951—December 31, 1951," Dept. of Agr., Raleigh, N. C.

Soils

"Soil Survey of Prince Edward Island," Exp. Farms Serv., Charlottetown, P. E. I., Can., G. B. Whiteside.

"The Seasonal Variation in pH of Hawaiian Soils," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii, Tech. Bul. No. 14, Aug. 1951, Y. Kanehiro, Y. Matsusaka, and G. D. Sherman.

"Illinois Acreage by Counties," Soil Testing Lab., Univ. of Ill., Urbana, Ill., AG1523a, Dec. 7, 1951, A. U. Thor and W. J. Armon.

"Total Potash, Phosphate and Limestone Needs in Illinois Counties 1950, Soil Testing Lab., Univ. of Ill., Urbana, Ill., AG1523b, Dec. 10, 1951, A. U. Thor and W. J. Armon.

"Limestone Requirements of Illinois Counties —1950," Soil Testing Lab., Univ. of Ill., Urbana, Ill., AG1525, Dec. 26, 1951, A. U. Thor and W. J. Armon.

"Water and Our Forests," Forest Serv., USDA, Wash., D. C., Agr. Info. Bul. No. 71, Dec. 1951, B. Frank and C. A. Betts.

"Soil Survey—Scott County, Virginia," Agr. Res. Admin., USDA, Wash., D. C., Series 1939, No. 13, Dec. 1951.

"Soil Testing in the United States," W. L. Nelson, Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Dec. 1951.

Crops

"Alaska Agricultural Experiment Station Thirteenth Progress Report 1948," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, June 30, 1949.

"Small Grain Yields in Arkansas 1946-50," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 25, June 1951, W. J. Wiser and H. R. Rosen.

"Sweet and Field Corn Report, Mt. Carmel and Windsor, Connecticut, 1951," Agr. Exp. Sta., Univ. of Conn., New Haven, Conn., Rpt. of Progress 51 G1, Feb. 1, 1952, D. F. Jones, H. L. Everett, and D. B. Walden.

"Four New Hibiscus Varieties," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii, Cir. 35, Feb. 1952, H. Y. Nakasone and R. A. Hamilton.

"1951 Performance of Private and Open-pedigree Corn Hybrids in Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Cir. 380, Jan. 1952, J. E. Newman, S. R. Miles, and P. L. Crane.

"A Preliminary Report of Tests Conducted by the Red River Valley Agricultural Experiment Station, Box 5008, Bossier City, Louisiana 1951," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., J. Y. Oakes, L. L. McCormick, and H. W. Ivy.

"Red Clover Varieties and Strains," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 44, A. O. Kuhn.

"Early Tomato Production in Michigan," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Cir. Bul. 220, Feb. 1952, S. H. Wittwer and A. N. Reath.

"Planting and Growing Cottonwood on Bottomlands," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 485, Oct. 1951, L. C. Maisenhelder.

"Growth and Flowering Characteristics of Camellias," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 160, June 1951, F. S. Batson.

"The Effects of Thermal-Neutron Irradiation of Maize and Barley Kernels," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Res. Bul. 167, Jan. 1951, J. W. Schmidt and E. F. Frolik.

"Performance of Soybean Varieties in Nebraska 1948-1951," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Testing Cir. 21, Feb. 1952, A. F. Dreier, D. G. Hanway, and R. S. Matlock.

"Gardening in New Mexico," Ext. Serv., N. Mex. A & M College, State College, N. Mex., Cir. 231, June 1951, L. C. Gibbs.

"Frame Gardens," Ext. Serv., N. Mex. A & M College, State College, N. Mex., Cir. 232, June 1951, L. C. Gibbs.

"North Carolina Accepts the Challenge through a United Agricultural Program," Dept. of Agr., Raleigh, N. C.

"Tobacco Plant Production Guide—Flue Cured Tobacco," Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. No. 363, Dec. 1951, R. R. Bennett and S. N. Hawks.

"Burley Tobacco Plant Production Guide," Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. No. 364, Dec. 1951, R. R. Bennett and S. N. Hawks.

"Garden Guide—Grow-Conserve-Eat," Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. No. 365, Jan. 1952, H. R. Niswonger, H. R. Garriss, T. M. Dobrovsky, R. E. Bryan, and N. Orr.

"1951 Hybrid Corn Field Trials," Agr. Exp. Sta., N. D. State College, Fargo, N. D., Agron. Mimeo Cir. 84, Jan. 1952, W. Widdakas and R. B. Widdifield.

"Oklahoma Cotton Varieties; Varietal Descriptions, and Performance Test Results, 1945-1951," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Bul. No. B-381, Feb. 1952, J. M. Green, M. G. Keathley, E. S. Oswalt, and N. M. Gober, Jr.

"Establishment of Grasses and Legumes," Forage Crops Leaf. No. 1, Jan. 1952, J. R. Harlan and W. C. Elder; "Seeding Rates of Grasses and Legumes," Forage Crops Leaf. No. 2, Jan. 1952, J. R. Harlan, W. C. Elder, and R. A. Chessmore; "Forage Crops Recommended in Oklahoma," Forage Crops Leaf. No. 3, Jan. 1952, J. R. Harlan, W. C. Elder, and R. A. Chessmore; "Tall Fescue (Festuca Arundinacea)," Forage Crops Leaf. No. 5, Feb. 1952, J. R. Harlan and W. C. Elder; "Blue Panic (Pancium Antidotale)," Forage Crops Leaf. No. 6, Feb. 1952, J. R. Harlan; "Caucasian Bluestem (Andropogon Caucasicus)," Forage Crops Leaf. No. 7, Feb. 1952, J. R. Harlan; "Smooth Brome (Bromus Inermis)," Forage Crops Leaf. No. 8, Feb. 1952, R. A. Chessmore and J. R. Harlan; Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla.

"Science for the Farmer," Agr. Exp. Sta., Pa. State College, State College, Pa., Suplt. No. 2, Bul. 540, 64th A. R., Mar. 1952, H. A. Meyer and H. N. Cope.

"The 1951 Cotton Contest, South Carolina," Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 366, Jan. 1952, H. G. Boylston.

"Citrus Variety Trends in the Lower Rio Grande Valley," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Bul. 742, Dec. 1951, D. C. Alderman.

"Grain Sorghum By-product Feeds for Farm Animals," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Bul. 743, Dec. 1951.

"Performance of Cotton Varieties in Texas 1948-50," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Bul. 739, Sept. 1951, D. T. Killough, E. F. McFarland, T. R. Richmond, and F. C. Elliott.

"Castor Beans in Texas," Ext. Serv., Tex. A & M College, College Station, Tex., B-195.

"Results of Hybrid Corn Yield Trials in West Virginia, 1951," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Current Rpt. No. 1, Feb. 1952, J. L. Cartledge, R. J. Friant, and C. W. Neal.

"Christmas Trees—Their Profitable Production in West Virginia," Agr. Exp. Sta., W. Va. Univ., Morgantown, W. Va., Cir. 82, June 1951, E. H. Tryon, A. W. Goodspeed, R. P. True, and C. J. Johnson.

"Winter Oats for the South," USDA, Wash., D. C., Farmers' Bul. No. 2037, Dec. 1951, T. R. Stanton and F. A. Coffman.

"Descriptions of and Key to American Potato Varieties," USDA, Wash., D. C., Cir. 741, Nov. 1951, C. F. Clark and P. M. Lombard.

"Ten Peaches and a Nectarine for the Western States," USDA, Wash., D. C., Cir. 885, Nov. 1951, C. O. Hesse and L. A. Thompson.

"Studies of Soil Moisture and Spacing for Seed Crops of Carrots and Onions," USDA, Wash., D. C., Cir. 892, Dec. 1951, L. R. Hawthorn.

"Report of the Federal Experiment Station in Puerto Rico 1951," Fed. Agr. Exp. Sta., Mayaguez, Puerto Rico, Dec. 1951.

"Report of the Chief of the Bureau of Agricultural and Industrial Chemistry Agricultural Research Administration," USDA, Wash., D. C.

"Report of the Chief of the Office of Experiment Stations, Agricultural Research Administration, 1951," USDA, Wash., D. C.

"Report of the Chief of the Forest Service 1951—Natural Enemies of Timber Abundance," USDA, Wash., D. C.

Economics

"American-Egyptian Cotton—An Economic Analysis," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 238, Nov. 1951, S. Hathorn, Jr.

"Labor and Material Requirements for Crops and Livestock II. Truck Crops," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 489, Jan. 1952, A. H. Spurlock, D. L. Brooke, and R. E. L. Greene.

"Pasture Costs and Returns in Central Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Cir. 376, Oct. 1951, P. R. Robbins.

"Effect of Corn Price Supports at Various Levels," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Cir. 377, Dec. 1951, B. K. Meeker and J. C. Bottum.

"What to Look for When Buying a Farm," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 42, A. B. Hamilton.

"Population Trends and Labor on Southern Farms 1949-1950," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 168, Dec. 1951, H. A. Pedersen.

"North Carolina's 1952 Agricultural Outlook," Ext. Serv., N. C. State College, Raleigh, N. C.

"The Agricultural Outlook South Carolina, 1952," Ext. Serv., Clemson College, Clemson, S. C., Cir. 368, Dec. 1951.

"Economic Land Classification of Smyth County," Agr. Exp. Sta., Va. Poly. Institute, Blacksburg, Va., Bul. 446, Sept. 1951, G. W. Patteson and Z. M. K. Fulton, Jr.

"Economic Land Classification of Bath County," Agr. Exp. Sta., Va. Poly. Inst., Blacksburg, Va., Bul. 447, Oct. 1951, G. W. Patteson and Z. M. K. Fulton, Jr.

"Keeping up on the Farm Outlook," Ext. Cir. No. 202, Jan. 31, 1952; "Keeping up on the Farm Outlook," Ext. Cir. No. 203, Feb. 29, 1952; Ext. Serv., State College of Wash., Pullman, Wash., K. Hobson.

"Annual Report on Tobacco Statistics 1951," Pro. & Mktg. Admin., USDA, Wash., D. C., Stat. Bul. No. 103, Dec. 1951.

"Report of the Solicitor to the Secretary of Agriculture for the Fiscal Year Ended June 30, 1951," USDA, Wash., D. C.

"Report of Activities under the Research and Marketing Act 1951," Agr. Res. Admin., USDA, Wash., D. C.

"Report of the President of the Commodity Credit Corporation, 1951," USDA, Wash., D. C.

"Report of the Administrator of the Commodity Exchange Authority, 1951," USDA, Wash., D. C.

"Report of the Manager of the Federal Crop Insurance Corporation, 1951," USDA, Wash., D. C.

"Agricultural Conservation Program Statistical Summary 1950," Pro. & Mktg. Admin., USDA, Wash., D. C., Dec. 1951.

"The Agricultural Conservation Program Handbook (1061) for 1952 for: Ariz., Conn., Del., Fla., Ga., Ill., Ind., Iowa., Kans., Ky., La., Md., Mass., Mich., Minn., Miss., Mo., N. H., N. Mex., N. Y., Nev., N. D., Ohio, Oreg., R. I., S. C., S. D., Tex., Va., Wash., W. Va., Wis., Wyo., Alaska, Hawaii, Puerto Rico, Virgin Islands; USDA, Pro. & Mktg. Admin., Wash., D. C.

Use of a Soil Test Summary . . .

(*From page* 20)

needed. For example, the data on samples for corn recommendations in one area in eastern North Carolina are presented in Table III. It can be readily seen that a high percentage of the soils are high in phosphorus and low in potassium. Under these conditions, a high proportion of the corn recommendations would include a 6-6-12. The opposite condition might exist in some areas where a high percentage of the soils are low in phosphorus and high in potassium. In these areas, many of the fertilizer recommendations for corn would suggest a 5-10-5. If the most efficient use is to be made of fertilizer materials, then the analysis fertilizer which will correct soil deficiencies should be available to the farmers.

Experiment station agronomists: Soil test summaries can be useful to experiment station workers in determining where soil fertility investigations are urgently needed. A knowledge of the areas in the state that are low or high in a given nutrient element may help to point to the need for studies regarding fertilizer responses of crops being grown in these areas.

In addition, the averages of soil tests on samples from farmers' fields may provide a basis for selecting experimental fields that more nearly represent average fertility levels of soils on which various crops are being grown.

A consideration of the summaries along with careful consideration of experimental work is helpful in making recommendations for the establishment of new fertilizer grades. The fact that in North Carolina over 80% of the tobacco soils tested were high or very high in phosphorus and 50% were low or very low in potash helped in pro-

TABLE III.—A HIGH PERCENTAGE OF THE SAMPLES FOR CORN IN TYPE OF FARMING AREA NO. 3 WERE HIGH IN PHOSPHORUS AND LOW IN POTASH *

Level	Plant Food	
	P	K
	%	%
VL	2	14
L	12	51
M	13	24
H	24	7
VH	49	4

* 835 samples analyzed.

posing a 4-8-10 as a recommended tobacco fertilizer as a substitute for 3-9-6.

Summary

Recognizing the fact that the main objective in soil testing is to obtain a basis for supplying farmers with dependable information as to the lime and fertilizer needs of each field, summaries of these soil tests may show general fertility levels. The summaries can be useful to local agricultural leaders, extension specialists, industry agronomists, and experiment station workers in promoting their respective programs.

A summary of soil tests in North Carolina during the period July 1, 1949, to June 30, 1950, was published and distributed to local and state agricultural leaders.

Some of the more important applications of these data are as follows:

1. The summary revealed the general need for lime. The soils in the Coastal Plain were somewhat more acid than those in the Piedmont and Mountain regions. The forage crops, alfalfa, ladino-grass and other pastures showed the greatest need for lime.

2. The counties having soils with the highest phosphorus levels were in the Coastal Plain. The phosphorus levels were related to past fertilization. In contrast to phosphorus, the potassium content was highest in the Piedmont and Mountain regions and is related to general soil association.

3. The soil tests, summarized on a county basis, help to point out to county agricultural leaders the general levels of fertility and indicate nutrients which are likely to be deficient.

4. Agronomy extension specialists can utilize information in soil test summaries to emphasize the need for special fertilization in accordance with soil needs, for example, 4-8-10 on tobacco and extra superphosphate or muriate of potash for improved pastures.

5. Data in soil test summaries may be used as a basis for fertilizer and lime industry agronomists to predict what

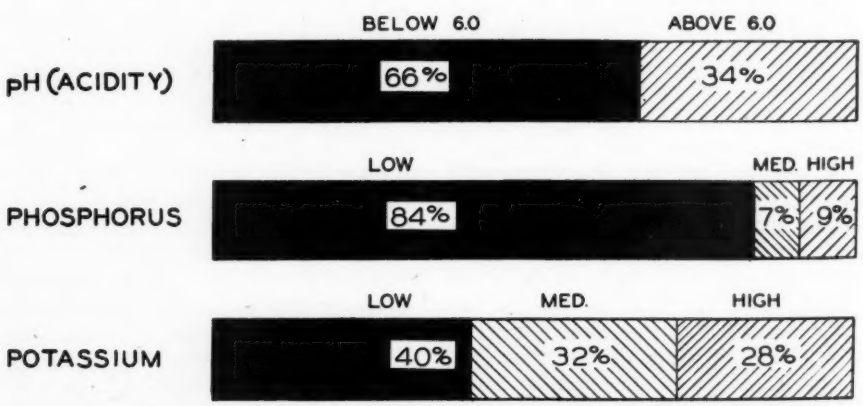


Fig. 5. Ladino-grass in area 7 (382 samples). A high percentage of the samples tested for ladino-grass pastures in type of farming area 7 were acid and low in phosphorus.

analysis fertilizer will be most recommended for specific crops in an area or county and where lime is most needed.

6. Soil test summaries may help experiment station soil fertility workers in obtaining an idea as to the fertility level of soils on which various crops are being grown. These averages of samples from farmers' fields may aid in pointing to the soil conditions that need further study.

7. It should be emphasized that soil test summaries represent averages and are of very little value in showing the fertility level of a given field. The best method of determining the specific lime and fertilizer needs is to test soil samples from each field.

Soybeans Need Fertilizer . . .

(*From page* 26)

sium, alone and in combination with nitrogen, phosphorus, and trace elements. Two of the tests were conducted at the Rice Branch Experiment Station at Stuttgart and three were conducted on outlying rice farms. In test No. 4 (see Table I) the fertilizer was mixed into the soil before the beans were planted. In the other tests the fertilizer was applied as a sidedressing a few inches on each side of the row when the beans were about 6 to 8 inches high. In test 1, the previous crop was soybeans; in test 2, cotton; and in tests 3, 4, and 5, rice. In tests 1, 2, and 3 severe chlorosis was present when the fertilizer was applied. In test 4 chlorosis appeared on the check plots when the plants were about 10 inches high. In test 5 no chlorosis was observed during the growing season. Potash had been applied to the rice that preceded soybeans on this farm in test 5.

Observations on the severity of chlorosis on rows receiving various treatments, from the time the fertilizer was applied until harvest, showed that potassium alone, or in combination with phosphorus, nitrogen, and Esminel, prevented chlorosis when applied at the time of planting, and resulted in marked recovery of the plants when applied as a sidedressing after the plants were showing deficiency symptoms.

The results also showed outstanding yield response to combined applications of potassium and phosphorus, but no

TABLE I.—RESULTS OF SOYBEAN FERTILIZER TESTS ON RICE FARMS AND AT THE RICE BRANCH EXPERIMENT STATION, STUTTGART, ARKANSAS, 1950

Treatment	Average yield, bushels per acre				
	Test 1	Test 2	Test 3	Test 4	Test 5
1. No fertilizer	12.6	11.6	15.4	17.0	29.8
2. Potash	19.9	26.9	21.5	22.1	35.1
3. Potash, Phosphate	23.5	30.0	25.8	32.1	40.9
4. Potash, Phosphate, Nitrogen	23.8	30.6	30.4	31.6	36.5
5. Potash, Phosphate, Nitrogen, Trace Minerals	23.0	29.6	32.2	31.6	38.9

Potash = 168 lbs. 0–0–60 per acre
Phosphate = 500 lbs. 0–20–0 per acre
Nitrogen = 150 lbs. 16–0–0 per acre
Trace Minerals = 40 lbs. Es-Min-El per acre

significant response to nitrogen or Esminel. Yield increases from the relatively heavy applications of 100 lbs. P_2O_5 and 100 lbs. K_2O per acre varied from 10 to 18 bushels per acre over the check plots in the five tests. The minimum increase of 10 bushels of soybeans, calculated at the season average price of $2.00 per bushel, returned a profit of approximately $7.00 per acre over fertilizer cost.

The following year a more detailed experiment was conducted to determine the effects of various amounts and combinations of phosphate and potash (Table II). The soil on the experimental area contained 1.7% organic matter, 8 ppm. available phosphorus, 20 ppm. available potassium, 2,800 ppm. available calcium, 160 ppm. available magnesium, and a pH of 7.3 to 7.6. All treatments were applied as a sidedressing 6″ to each side of the row and 3″ deep, when the beans were 6 to 8 inches tall. Chlorosis did not occur on any plots until the beans were approximately a foot tall, after which time increasingly severe symptoms of potash deficiency became apparent on all plots which did not receive potash. Chlorosis was generally most severe on the lower leaves of the plant. Plants which were fertilized with superphosphate alone showed more severe potash deficiency symptoms than unfertilized plants.

TABLE II.—RESULTS OF SOYBEAN FERTILIZATION EXPERIMENT AT RICE BRANCH EXPERIMENT STATION, STUTTGART, ARKANSAS, 1951

Treatment lbs. per acre	Average bushels per acre		Profit, if any,* over fertilizer cost
	Yield	Increase over no fertilizer	
1. No fertilizer	.....	.....	.....
2. 20# P_2O_5	16.2	−0.3	.....
3. 40# P_2O_5	18.3	1.8	.....
4. 40# K_2O	19.7	3.2	$4.44
5. 20# P_2O_5 40# K_2O	24.2	7.7	11.79
6. 40# P_2O_5 40# K_2O	25.5	9.0	12.74
7. 80# P_2O_5 40# K_2O	27.7	11.2	13.84
8. 40# P_2O_5 80# K_2O	25.9	9.4	11.58
9. 80# P_2O_5 80# K_2O	26.9	10.4	10.28
10. 80# P_2O_5 80# K_2O 32# N (cyanamid)	24.9	8.4	.....
11. 80# P_2O_5 80# K_2O 32# N 50# Es-Min-El	22.9	6.4	.....

* Soybeans at $2.00 per bushel, 0-20-0 at $1.65 per 100 lbs., 0-0-60 at $2.95 per 100 lbs.

The application of 40 lbs. P_2O_5 alone gave an increase in yield of 1.8 bushels over the check, while the 40-lb. K_2O application alone increased the yield 3.2 bushels, indicating that the available potash supply was limiting yield to a greater extent than the phosphorus supply (Table II). When both elements were used in various combinations, however, maximum yield increases were apparently determined by maximum levels of phosphate fertilization, rather than maximum levels of potash fertilization. Under the conditions of this experiment, the cyanamid and/or trace mineral treatments showed a slight tendency to decrease soybean yields. The profits gained from fertilizer treatments were estimated on the basis of season average soybean price and current retail fertilizer costs.

Methods of fertilizer application were compared in an adjoining experiment. The results indicated that sidedressing treatments, at low and high rates of fertilization, increased yields from 1.5 to 3 bushels per acre more than when the equivalent amounts of fertilizer were broadcast and disced in before planting.

Soybean production in the three major rice-producing counties in Arkansas averaged 20.5 bushels per

acre in 1950. The tests described indicate that the average yield could be increased profitably on many rice farms by a minimum application of 400 lbs. of 0-12-12 at planting or as a sidedressing during early growth. Future experiments are planned to determine the benefits that may be derived from heavier fertilization and larger plant populations, and effects of nitrogen applications at various times during the growth period.

No More Fodder Pullin' . . .

(*From page* 25)

them, it was futile to say that fodder pulling was an uneconomic practice. The cost of gathering the fodder wasn't especially important when the farmer's family generally furnished the labor. And the mule had to be fed.

This new type of farming was greatly accelerated by the soil conservation district program which got under way in 1937. The emphasis which the districts placed on using and treating the land according to its capability and needs meant that a lot of what had formerly been cotton and corn land went into pasture and hay crops. And through the same district program, new forage crops like tall fescue, reseeding crimson and ladino clover, sericea, kudzu, and many other plants were introduced and given widespread distribution.

How rapidly this program has spread across the area where fodder pulling was most common is indicated by the fact that in the Southeastern States bounded by the Potomac, Ohio, and Mississippi Rivers, more than 91 per cent of all the farm land is now in soil conservation districts. With assistance of technicians of the Soil Conservation Service assigned to these districts, farmers have planned for conservation farming more than 58 million acres, or 40 per cent of the farm land.

Along with the development of soil conservation districts has come the mechanization of farming operations in the Southeast. Farm equipment is not yet so plentiful in the South as it is in some of the other sections of the country. But farmers working together in neighborhood groups in soil conservation districts are making efficient use of what they have by pooling the equipment that is available. And the increased farm income that has resulted from improved farming methods is enabling them to speed up farm mechanization.

With tractor power replacing mule power on an ever-increasing number of farms, fodder is no longer needed to get the spring plowing job done. And year-round grazing that is possible in a large part of the Southeast, now that a wide variety of adapted pasture plants is available, has greatly reduced the

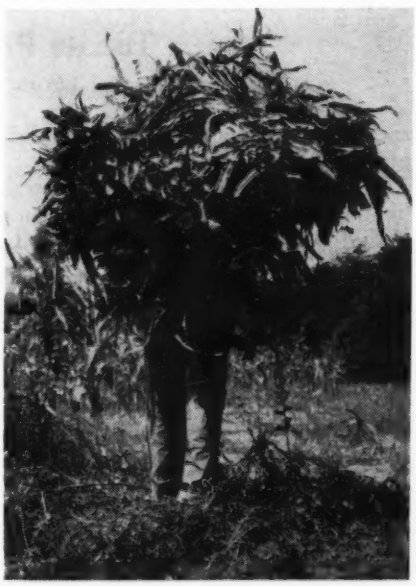


Fig. 2. An animated haystack heading for the barn.

need for all kinds of harvested feed. The cows are harvesting their own feed, cafeteria style, in most sections of the Southeast for 10 to 12 months of the year.

Many of these new crops are used for hay and with the coming of tractor-drawn mowing machines, the hay problem has been further simplified. An Alabama farmer, who has about 300 acres of open land, told me a year or so ago that he had 3,500 bales of hay on hand in late May.

"I thought I might need it during the winter, but the cows stayed on pasture most of the time," he said. "If anybody wants to buy it, all right. One fellow came along last week and bought a few bales. But if I don't sell it, I don't care."

What then, I inquired, did he intend to do with it?

"Well," he said thoughtfully, as if this hadn't occurred to him before, "if it rots, I'll haul it out to the field and spread it on the ground. In fact, I may do that anyway. I don't know of a better use I could make of it. After all, it didn't cost me anything but a few hours work."

Contrast that with the farmer of only two or three decades ago, who struggled to gather up a few hundred bundles of fodder and a ton or so of cowpea hay to tide him over until he could cut some green oats in the spring. The contrast gives a pretty good idea of a significance of the revolution that has taken place on Southern farms in a relatively few years.

There are nostalgic memories of fodder pulling in the South, just as there are of vanishing farm practices in other sections of the country. The toil and sweat are forgotten in contemplating more pleasant memories of a ripe, red watermelon broken over a stump, a cool drink at the spring, and a song in the moonlight.

But few would exchange for even these more pleasant aspects of the old days, the business-like hum of a tractor, the sight of well-fed cows resting in the shade, or the expanding carpet of green that is spreading over fields where gaunt cornstalks once stood when the fodder had been taken to the barn.

Tomato Production . . .

(*From page* 23)

and hoes are available to accomplish proper cultivation.

Before cultivation is attempted, the location of the root system of the plants should be determined so that the cultivator can be properly adjusted to accomplish the job without destroying roots.

Crop rotation is important in a stable agriculture. It is anticipated that this subject will be discussed elsewhere because a proper approach of the subject is beyond the scope of this article.

Insect and Disease Control

Adequate information is available for insect and disease control. This can be supplied by the experiment stations, county agents, and canner representatives.

Harvesting

It has been observed in many instances that even after a satisfactory crop has been grown many fail to adequately and properly supervise the picking and delivery of the crop. It is highly desirable to lift the vines to find the excellent fruit that ripens underneath the vines. In fact, during extremely hot weather the most satisfactory fruit for picking is that protected from the sun by adequate foliage. Many pickers fail to lift the vines in order to get this fruit and several tons of tomatoes can be lost in this manner. The moving of the vines allows air to penetrate and tends to mature and ripen the fruit.

The Inorganic Side of Life . . .

(*From page* 14)

Since this requires the use of the missing elements as fertilizer, the likelihood of their being lacking in foods and feeds is greatly lessened. Nevertheless, it is now common practice to add small amounts of copper sulfate to hog feeds and, where the pigs do not have contact with the soil, a solution of copper sulfate is painted on the sow's teats. Manganese sulfate, at 6 ounces a ton, is a more or less standard ingredient of poultry feeds as a protective agent against perosis. Occasionally copper and manganese sulfates are added to dairy cow feeds, and zinc sulfate or carbonate as well.

In this connection, it is important to note that the solubilities of the copper, manganese, and zinc in the soil are greatly reduced by liming and by the use of soluble phosphates. The tendency to over-lime and over-phosphate land is very marked in the more intensive farming areas, and difficulties have been experienced with livestock under such conditions.

Recently, on a farm in southern New Jersey, 74 cattle were lost by death or forced sale from hyperkeratosis, or X-disease. This farm had had a long and successful history as a dairy farm. But a very progressive son finally took over its management. Among other changes in practice, he greatly increased the use of lime and fertilizer. In due time, hyperkeratosis developed and, eventually, the son was forced out of the farming business. This disease is characterized by a thickening of the skin, notably of the shoulders and face, proliferations on the tongue and in the mouth, lachrymation, emaciation, and some tendency toward scouring. The udders of affected heifers have a texture somewhat like that of canvas.

For a time it was believed that excessive molybdenum, liberated by heavy liming, was the cause of the disease. Some of the oven-dry forage contained as much as 9 ppm. of this element. But this concept as to the cause has been discarded. More recently, our studies have suggested the possibility of zinc deficiency resulting from excessive use of lime and superphosphate. Biochemists have produced a similar disease in rats by withholding zinc from the diet.

The solubility of soil cobalt, an element that is known to be essential to animals but not to plants, is also decreased by liming. Cobalt deficiency in forage is known to be widespread. Such deficiency is at least partially responsible for "pine disease," "Morton's Main disease," "bush sickness," "salt sickness," "Burton's ail," and "Grand Traverse disease." The symptoms common to all these diseases are depraved appetite, progressive emaciation, anemia, retarded development of sexual characteristics, and muscular atrophy. The spleen shrivels. The hair or wool becomes harsh. Sheep are affected more than cattle and young stock more than old. In some cases, the only evidence of disease may be a very slow or no gain in weight.

Cobalt deficiency is most likely to occur in areas where the soil has been derived from acid igneous rocks, such as the granites, gneisses, and schists. It is less likely to be found in areas where the soils are derived from the more basic diorites and basalts. It is present in greatest abundance in rocks containing minerals that are high in iron and magnesium, since the atomic radii of these three elements are quite similar, varying between 0.78 and 0.83 Ä. Coral-reef soils tend to be low in cobalt, whereas volcanic soils are high in it.

The passing point for soils is of the order of 2 ppm. total cobalt, equivalent to about 4 pounds of the element in the plowed acre. Forage for sheep should contain 0.07 ppm. cobalt, but

somewhat smaller amounts apparently suffice for cattle. Most grasses are relatively low in cobalt, but bluegrass may be an exception. A sample of New Jersey bluegrass was found to contain 0.24 ppm. cobalt, more than was found in any other plant. Legumes tend to be high in cobalt. In proportion as they are present in the forage, cobalt deficiency for livestock is less likely to occur.

The problem here is as to whether it is better to add cobalt to the soil so that it may become an organic part of the plant, or whether the cobalt can be fed directly to animals. The normal rate of application of cobalt sulfate to deficient pasture soils is from 2 to 4 ounces an acre annually, in comparison with the 2 grams that is being added by some manufacturers to each ton of grain feed for cows. The economy of putting it in the feed is apparent, the cost being of the order of ¼ cent a ton.

Insofar as cows and other ruminants are concerned, direct addition of the mineral salt to the feed is entirely satisfactory. The cow's rumen is a living factory where feed is digested and new products are developed by bacterial synthesis. In this environment, vitamin B12, of which cobalt is a constituent, is synthesized. In the case of man and non-ruminants, the bacteria of the intestine may accomplish much the same purpose as the rumen of the cow. Thus the antibiotics, by reducing the activity of the microorganisms in the intestinal tract, have been shown to lower the synthesis of certain vitamins, with resulting faulty nutrition.

Safety in Variety

One of the best means of meeting the mineral requirements of animals is by having as wide variety of materials in the feed as possible. The tendency to have animals grazing on pure stands of one or two forage plants is wrong in principle. In this connection, there is something to be said in favor even of weeds, since they add mineral variety to the diet. Some weeds are known to be high in certain minor elements. Thus ragweeds are notably high in zinc.

Similarly the inorganic requirements of man can be met through choice of foods from many areas. When one considers that plant products from all over the world find their way to the table, it would appear that man's needs for all the essential minerals would thus be met. It must be admitted, however, that this is a "hit-and-miss" system, and that many cases of deficiency may develop under such a procedure. In this connection, it is conceivable that more difficulty from minor-element deficiencies may be experienced by folks on the farm than by those in the city, since a larger part of the farmer's food is derived from one source.

Meat, eggs, and milk have high protective value for man, in terms of inorganic elements. Animals tend to effect a screening process by which nonessential and injurious elements are largely eliminated. In the worst cases, the animal loses its life while serving as an "official taster" for man. There are other advantages in an animal economy, since if eggs and milk are to be produced economically all the needs of the animals must be met, and their mineral needs are quite similar to those of man. The livers of animals are especially valuable as sources of minor elements. Seafood is also very important in this connection.

Within recent years a great deal of publicity has been given to organic gardening and farming in which dependence is placed on manures and composts rather than on mineral fertilizers. It is apparent that, in proportion as more organic materials can be accumulated and used, a supply of all the necessary mineral elements is more likely to be maintained in the soil. This is especially true of back-yard compost that may contain plant materials from all over the earth. Thus the refuse from Brazilian coffee, Yucatan bananas, Florida oranges, California carrots, Rio

Grande Valley vegetables, home-state crops, and home-garden produce all find their way into the compost pile.

It would seem that the people of the United States of America are not in dire need of extra minerals, including the minor elements, since our life-expectancy at birth is now over 65 years. Yet it is well known that if all man's nutritional and other needs were met his span of life might well be more than a century. Certainly some of the ills of man can be traced to deficiencies of one or another or several of the inorganic elements. It is doubtful whether a longer average life is so much to be desired as a more healthful life while it is being lived. That might well be possible through a better balanced diet of the inorganic elements.

Potash for Pecans

By Clyde Beale

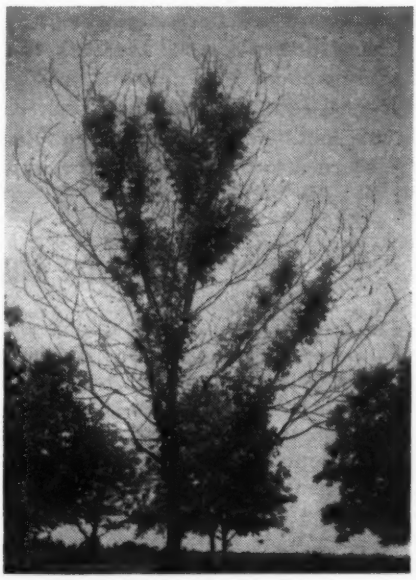
Agricultural Extension Service, Gainesville, Florida

SIGNIFICANTLY higher yields of nuts have been obtained from pecan trees receiving 5-10 lbs. of potash per year than from trees that were given no potash, according to G. H. Blackmon and Ralph H. Sharpe of the University of Florida Agricultural Experiment Stations.

In tests at the North Florida Experiment Station at Quincy, Horticulturists Blackmon and Sharpe applied 5 or 10 lbs. of muriate of potash to each of a group of trees—5 lbs. to some, 10 lbs. to others—and the yields were significantly higher than yields from trees receiving the same treatment except for the potash application. Reseeding crimson clover was used as a cover crop in the orchard.

They also found trees of the Moore variety that received potash were not as severely damaged by low temperatures as trees that were given no potash.

While the trees receiving 10 lbs. of potash each produced somewhat higher yields than those receiving 5 lbs., the Florida workers found that the difference in yields between the two groups was not large enough to justify the 10-lb. application. They recommend about 5 lbs. per tree for maximum results from the material used.



The tree in the foreground received no potash and was much more severely damaged by low temperatures than those to the sides and rear which were given applications of potash.

The trees that received no potash produced an average yield of 19 lbs. per tree, while those that received 5 lbs. of muriate of potash produced an average yield of 25.2 lbs., or 6.2 lbs. more nuts per tree than the trees that received no potash.

Crops Become Weeds and Weeds Become Crops

FARMERS not only need to know how to make crops grow and yield well, but in some cases how to keep them from getting the upper hand. Many a troublesome weed, according to specialists of the U. S. Department of Agriculture, got its start through being welcomed to the farm as a crop.

Bermuda grass (the ordinary kind now spoken of bitterly in the South as "cotton patch" bermuda) came from India where it was considered a gift from God as feed for the sacred cow. It is a good seed-producer and spreads easily to fields intended for other crops, a bad characteristic in a plant used for pasture in a row-crop area.

Now the new Coastal Bermuda, that highly productive hybrid between Tift, a special strain, and another Bermuda from South Africa, is increasing the Southern farmer's regard for the crop. Unlike the "cotton patch" kind, Coastal Bermuda produces almost no viable seed, a considerable factor in keeping it where it is wanted. It is propagated by means of sod plugs or vegetative cuttings.

There are several other crops whose histories contain similar variations from disfavor to popularity or at least usefulness. Johnson grass was introduced as a pasture possibility in the South and soon spread as a weed. It was finally adopted as a pasture grass because farmers found it too difficult to eradicate. Sweet clover, on the other hand, came in as a weed—probably in ship ballast in the early 1700's—and finally became a valuable soil-improver, pasture and hay crop, with improved strains now widely grown.

A weed is commonly known as a plant out of place, but, say the agronomists, sometimes a place can be found for it or it can be kept in its place.

Doctors for Sick Farms

IN a comparison of soil erosion and human illness, H. H. Bennett, former Chief of the Soil Conservation Service, U. S. Department of Agriculture, stated: "In a sense the farmer is like a patient who normally depends upon a general practitioner to keep him well and to treat small ailments. When the patient gets heart trouble, however, he calls in a cardiac specialist. When he develops discomfort in the chest, he may find it advisable to consult a specialist in pulmonary disorders. If he develops other serious or not readily understood complications, he calls still other medical specialists.

"The average farm, with its different crops—trees, grass, small grain, and row crops—and its varied land classes and conditions, needing erosion control, drainage, woodland management, pasture management, and water control, is like a patient beset with a complication of diseases, many of which are beyond the powers of 'home doctoring' or even of the general practitioner. Specialists are needed, and these specialists are the technicians that the Soil Sonservation Service assigns to soil conservation districts to help cooperating farmers and ranchers diagnose and treat ailing land. In addition to their specialized fields of knowledge, however, these technicians have another prime qualification: all of them are trained soil and water conservationists. They are trained to coordinate their special knowledge with the over-all principles that are the basis of the national program to conserve America's soil and water resources."

Pine Hybrid Shows Promise

BECAUSE of the wide distribution and commercial importance of ponderosa pine, Forest Service research men at the Institute of Forest Genetics at Placerville, Calif., have been experimenting with using ponderosa as a parent of bigger and faster-growing pines.

By crossing the ponderosa with the Apache pine they have come up with a hybrid which at the end of six years has longer and heavier roots, a thicker stem, thicker bark and greater height, heavier foliage and higher water content than the ponderosa.

The first cross-pollinations were made in 1943. At the end of one year the hybrid seedlings consistently bore more bundles of needles than did the non-hybrid ponderosa pines from the same seed trees. The hybrids had also sent down much longer taproots. At the end of the two-year growing period the hybrid trees had shorter tops but in all other respects they already showed superior characteristics.

Findings are not yet complete enough to compare the hybrid precisely with both parents. The accelerated early growth may indicate that the hybrid will reach maturity and decline faster than the ponderosa parent. The Apache pine grows rapidly between the ages of 8 and 75 years and lives only from 175 to 200 years. The ponderosa pine, on the other hand, starts more slowly and often lives more than 700 years. If the hybrid possesses the good construction qualities of its ponderosa parent—and it seems to—it would be a great gain to get material for framework, sheathing, doors, knotty pine paneling, crating, railroad ties, and fuel at the earlier ages.

Unfortunately the hybrid, like the ponderosa, is susceptible to killing by the pine-reproduction weevil. New experiments are under way to introduce the Coulter pine strain into the hybrid. The Coulter pine has a high resistance to the weevil. This may require several successive hybridizations, and such a new hybrid eventually may count as many as four species in its pedigree.

Farmers and Foreigners . . .

(*From page* 5)

There are others, too, who think the Land-Grant Colleges and the Federal Department of Agriculture have been obliged to furnish too much technical manpower for foreign programs, leaving our own taxpayers without adequate research, educational, and economic leadership. All these are passing expressions, not always too firmly held and open to further modification.

What are some of the obstacles to be overcome in developing mutual understanding between our citizens and those of foreign lands?

The failure to see and believe that we receive benefits, as well as render benefits to other nations, was mentioned first. It has taken a long time and much effort to educate ourselves that we are not strong enough to stand isolated and alone.

Lack of sufficient interchange of experiences is evident among local leaders who chart the grassroots movements for international outlooks and active efforts. This leads to inertia and frustration among those who assume responsibility for keeping the world viewpoint in mind. Certain political differences interfere and prevent the exercise of calm judgment on many foreign issues. High costs of maintaining the overseas programs were cited. Rival trade and tariff positions

are often present to cause disunity and bad feeling on matters concerning other nations.

Some rural leaders said that poorly planned and inefficient local programs on world issues discourage good and steady attendance at meetings. Others claimed the local newspapers and radio stations do not give enough support to foreign aid, with some exceptions. Here it was pointed out that country papers are usually small ones whose main function is to devote space to home doings and local interests. They leave the ambitious analytical articles to larger publications which lack local flavor or significance.

Probably a greater deterrent to local enthusiasm for UN matters lies in the great number of local organizations existing today in most well-developed communities. Farmers belong to and attend church, civic, commodity, livestock, fraternal, social, and educational organizations handling subjects closer to the home farm and problems which a rural individual can act upon himself —not through some distant New York or Washington office.

Natural language and historical barriers always thrust in between sponsors of world uplift plans and the mental and habitual attitudes of local people in general. A little of this has been erased by the International Farm Youth Exchange. While the remedy from that quarter is inspiring, it is slow. It is perhaps more effective here than abroad.

Moreover, local leaders lack adequate training or experience as a rule and there are too few competent speakers to be had. The expenses involved when distant authorities are sought is almost prohibitive. They can be secured for large State meetings, but interior communities simply cannot afford them.

Despite the existence of many of these obstacles and frustrations, reports made by such an assembly of local rural leaders as those who met at Hunter College last January bring out facts about the tremendous amount of work that is accomplished. Given any kind of a chance or incentive, our farm forces usually renew as far as they can their efforts to extend aid and comfort to their underprivileged brethren everywhere. In a vague way, sometimes groping along, our rural communities want to promote greater skills, better equipment, sounder farm credit systems, land tenure improvements, cooperative marketing, and scientific research. In a broad sense they wish to share such privileges with foreigners.

Delegates recounted activity by Granges, Farm Bureaus, Farmers Union groups, home demonstration agents and homemakers' clubs, and even by a few State Councils and Committees engaged in sponsoring United Nations goals, insofar as they relate to rural affairs.

Such programs take the form of tours to the United Nations headquarters, use of films and library aids, hearing youthful speakers who have observed conditions abroad, studies of special countries and their foods and recipes by women's clubs, debates, motion pictures, radio discussions, and neighborhood socials.

WHAT resources are available for use by rural and farm groups to encourage and satisfy the yen for more facts about foreigners?

The United Nations, of course, has a wealth of helpful material for use by all media. Colleges and State universities, foreign-born citizens and societies, and farm magazines are always sources of good ideas. Returned leaders known to the community who have taken part in UN and ECA overseas programs are good persons to consult. In recent seasons more farm-tour parties have seen things for themselves in Europe and Asia, and have come home loaded with facts and opinions, as well as fine embroidery and cuckoo clocks.

Is there real need for closer coopera-

tion between farm and nonfarm organizations serving rural zones to help promote fuller world viewpoints? The answer is "yes." Lack of such coordination is not so much owing to antagonism as the failure to fit into each other's circle of study. Here there is more room for some kind of Statewide clearinghouse through a voluntary council—wherein Kansas and Minnesota seem outstanding examples. Without such a guiding point, a local group is isolated and at some disadvantage when dealing with the distant official headquarters.

Here we may paraphrase a statement made at Hunter College by Mrs. Mildred B. Sayre, well-known women's leader in the Farm Bureau Federation. In a way her thought seems to express the attitude of most farm folks regarding their present assignment in the international scene:

It is not merely how the United Nations agencies may get constant support from our farm and rural sources. Rather it is how our own growing desire to aid and advance world peace and welfare may find practical ways to use the services of the UN agencies to accomplish our purpose.

In other words, it is the message and the mission that counts most—not the organization machinery itself, often too complex and regimented.

Perhaps it is too much to expect our country to pursue a continued course of foreign aid—such as the world has never seen one country do before—without a break or two in the enthusiasm and financial means thereto. Yet we have made a great beginning and expended large sums and prodigious talent in behalf of what we assume to be a job that destiny has set for us to finish. The danger point will come when we face discouragement and imagine that we have failed. What will be the answer of our farm folks to a move back toward isolation? Only time and the mood of our own people and the degree of prosperity we enjoy will bring us any final solution.

Time Proven LaMotte Soil Testing Apparatus

LaMotte Soil Testing Service is the direct result of 30 years of extensive cooperative research with agronomists and expert soil technologists to provide simplified soil testing methods. These methods are based on fundamentally sound chemical reactions adapted to the study of soils, and have proved to be invaluable aids in diagnosing deficiencies in plant food constituents. These methods are flexible and are capable of application to all types of soil with proper interpretation to compensate for any special soil conditions encountered.

Methods for the following are available in single units or in combination sets:

Ammonia Nitrogen	**Iron**
Nitrate Nitrogen	**pH (acidity & alkalinity)**
Nitrite Nitrogen	
Available Potash	**Manganese**
Available Phosphorus	**Magnesium**
Chlorides	**Aluminum**
Sulfates	**Replaceable Calcium**

Tests for Organic Matter and Nutrient Solutions (hydroculture) furnished only as separate units.

LaMotte Combination Soil Testing Outfit

Standard model for pH, Nitrate, Phosphorus and Potash. Complete with instructions.

Illustrated literature will be sent upon request without obligation.

LaMotte Chemical Products Co.

Dept. BC **Towson 4, Md.**

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest)
The Cow and Her Pasture (General)

Reprints

F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
I-2-47 Fertilizers and Human Health
T-4-47 Fertilizer Practices for Profitable Tobacco
AA-5-47 The Potassium Content of Farm Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
R-4-48—Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
OO-11-48 The Use of Soil Sampling Tubes
TT-12-48 Season-long Pasture for New England
F-2-49 Fertilizing Tomatoes for Earliness and Quality
CC-8-49 Efficient Vegetable Production Calls for Soil Improvement
KK-10-49 An Approved Soybean Program for North Carolina
QQ-11-49 Some Fundamentals of Soil Building
RR-11-49 Alfalfa as a Money Crop in the South
SS-12-49 Fertilizing Vegetable Crops
F-1-50 A Simplified Field Test for Determining Potassium in Plant Tissue
I-2-50 Boron for Alfalfa
K-3-50 Metering Dry Fertilizers and Soil Amendments into Irrigation Systems
L-3-50 Food for Thought About Food
O-4-50 Birdsfoot Trefoil—A Promising Forage Crop
S-4-50 Year-round Green
V-5-50 Potassium Cures Cherry Curl Leaf
X-5-50 Fertilizers Help Make Humus
Z-6-50 Potash Tissue Test for Peach Leaves
AA-8-50 Alfalfa—Its Mineral Requirements and Chemical Composition
BB-8-50 Trends in Soil Management of Peach Orchards
HH-11-50 The Minor Element Problem
II-11-50 Tree Symptoms and Leaf Analysis Determine Potash Needs
KK-12-50 Surveying the Results of a Green Pastures Program
NN-12-50 Plenty of Moisture, Not Enough Soil Fertility
A-1-51 Soil-testing Reduces Guesswork
B-1-51 Alfalfa, Queen of Forage Crops
G-2-51 Grassland Farming Brings New Management Problems
I-2-51 Soil Treatment Improves Soybeans
J-3-51 Fertilizing the Corn Crop in Wisconsin
K-3-51 Increasing Cotton Yields in North Carolina
M-3-51 A Look at Alfalfa Production in the Northeast
N-4-51 Nutritional Problems of Peanuts in Southeastern Alabama
O-4-51 More Corn at No Extra Cost
P-4-51 Thirty Tons of Tomatoes per Acre
S-5-51 The Development of the American Potash Industry
W-6-51 Does Potash Fertilizer Reduce Protein Content of Alfalfa?
X-8-51 Orchard Fertilization Ground and Foliage
AA-8-51 Topdressing Legume Meadows in Iowa
BB-10-51 Healthy Plants Must Be Well Nourished
CC-10-51 Producing Small Grain More Efficiently
DD-10-51 Fertilizers for Vegetable Crops, Rates, Placement, and Ratios
EE-10-51 Rotation Fertilization
FF-10-51 Soil-fertility Losses by Erosion
GG-11-51 Fertilizer Recommendations Based on Soil Tests
HH-11-51 Concerning "Bio-dynamic Farming" and "Organic Gardening"
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
JJ-12-51 Soil Fertility and Pastures
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
B-1-52 Simple Tests for Magnesium and Calcium in Plant Material and Magnesium in Soils

THE AMERICAN POTASH INSTITUTE
1102 16TH STREET, N. W. WASHINGTON 6, D. C.

FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)
The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)
The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)
The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)
Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)
Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)
Potash Production in America (Silent, running time 40 min. on 400-ft. reels.)
In the Clover (Sound, running time 25 min. on 800-ft. reel.)

OTHER 16 MM. COLOR FILMS AVAILABLE ONLY FOR TERRITORIES INDICATED

South: Potash in Southern Agriculture (Sound, running time 20 min. on 800-ft. reel.)
Midwest: New Soils From Old (Silent, 800-ft. edition running time 25 min.; 1200-ft. edition running time 45 min. on 400-ft. reels.)
West: Machine Placement of Fertilizers (Silent, running time 20 min. on 400-ft. reel.)
Ladino Clover Pastures (Silent, running time 25 min. on 400-ft. reels.)
Potash From Soil to Plant (Silent, running time 20 min. on 400-ft. reel.)
Potash Deficiency in Grapes and Prunes (Silent, running time 20 min. on 400-ft. reel.)
Bringing Citrus Quality to Market (Silent, running time 25 min. on 800-ft. reel.)
Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.
Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.
Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.
Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.
West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.
Canada: National Film Board, Ottawa, Ontario, Canada.

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

The officers at a near-by camp were giving a dance and delegated a persuasive young second lieutenant to ask the dean of a strait-laced women's college to allow some of the girls to attend. The dean promised to send a dozen of her best and most trustworthy students. The lieutenant hesitated. "Would it be possible," he finally asked, "to send half a dozen of that kind and half a dozen of the other?"

★ ★ ★

Little Gordon had arrived home from school with a cut lip and a black eye. "Dear me!" exclaimed his mother. "Do you mean to say you've walked through the streets like that?" "I had to, mum," grinned Gordon. "You see, there wasn't room for two of us in the ambulance."

★ ★ ★

Cleta: "Mary swears she's never been kissed."

George: "Maybe that's why she swears."

★ ★ ★

The Census Taker braved the backwoods of Tennessee to take a count of the backwoods families. When he asked one mountaineer how many children were in the family the man replied: "Four, an' by gosh that's all I'm gonna have.

"Why? Well, I'll tell ya. I just read in this here government almanac that every fifth child born in this here world is a Chinaman."

Ardent Lover: "Your eyes are beautiful. Your hair is like spun gold. Your eyes are like limpid pools of water at dusk. Your lips—your—. Boy, what a mess you must make of the rim of a coffee cup!"

★ ★ ★

Mose: "Heah, read me dis lettah fum mah gal, but fust put dis cotton in yo' eahs."

★ ★ ★

A hillbilly edged up to the ticket window of a jerkwater rail station.

"Mister," he said, "I aim to go to New York to fiddle with a hillbilly band. Can you fix me up to get there?"

"Certainly," replied the agent. "The special goes through here in about five minutes and I can flag her for you—but where's your trunk?"

"Trunk?" asked the puzzled mountaineer. "What's a trunk for?"

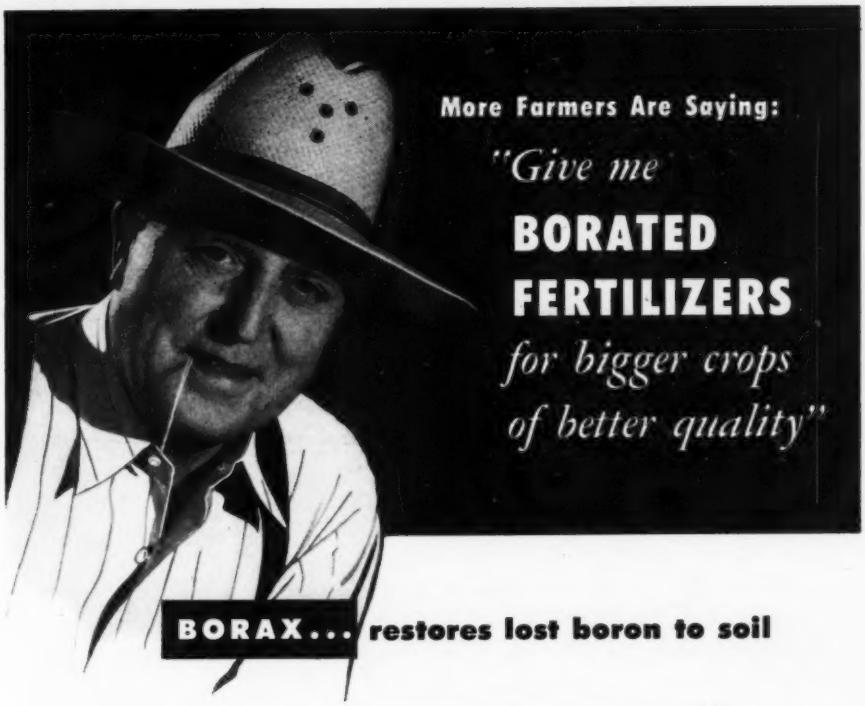
"To put your clothes in," replied the agent.

"What!" cried the scandalized hillbilly, "an' me go nekkid?"

★ ★ ★

A tourist from the prairie country, on stopping in a West Virginia mountain hamlet, approached a mountaineer who whittled away on a twig as he leaned against the village post office. "Tell me," he said, "is this whole area as mountainous as this town?"

"Shore is," replied the native. "Why, if we could get this one county smoothed out flat, it would be bigger than the State of Texas."



BORAX... restores lost boron to soil

• Agricultural authorities agree that boron is an essential plant food just as are nitrogen, potash and others. A boron deficiency in soil causes dwindling crops and puny plants... but borax restores lost boron. Users of our fertilizer borates* report increased yields of alfalfa, pasture crops and many vegetable, field and fruit crops, plus greatly improved quality.

* **FERTILIZER BORATE** (*equivalent to approximately 93% borax*) and **FERTILIZER BORATE—HIGH GRADE** (*equivalent to approximately 121% borax*) offer you low-cost, economical sources of boron... in fine mesh for addition to mixed fertilizer, or coarse mesh for direct application where required. County Agents or State Experimental Stations should be consulted for detailed recommendations. Write today for literature and quotations.

MANUFACTURERS OF FAMOUS "20 MULE TEAM" PACKAGE PRODUCTS

AGRICULTURAL OFFICES

• P.O. Box 229
East Alton, Illinois
• 1st Nat'l Bank Bldg.
Auburn, Alabama

PACIFIC COAST BORAX CO.
DIVISION OF BORAX CONSOLIDATED, LIMITED

100 PARK AVENUE
NEW YORK 17, N.Y.

2295 LUMBER STREET
CHICAGO 16, ILLINOIS

630 SHATTO PLACE
LOS ANGELES 5, CALIF.

You will want this book

DIAGNOSTIC TECHNIQUES

For

Soils and Crops

Their Value and Use in Estimating the Fertility Status of Soils and Nutritional Requirements of Crops

HISTORICAL INTRODUCTION

by

Firman E. Bear

Chemical Methods for Assessing Soil Fertility
by Michael Peech

Correlation of Soil Tests With Crop Response to Added Fertilizers and With Fertilizer Requirement
by Roger H. Bray

Operation of a State Soil-Testing Service Laboratory
by Ivan E. Miles and J. Fielding Reed

Operation of An Industrial Service Laboratory for Analyzing Soil and Plant Samples
by Jackson B. Hester

Plant-Tissue Tests as a Tool in Agronomic Research
by Bert A. Krantz, W. L. Nelson and Leland F. Burkhart

Plant Analysis—Methods and Interpretation of Results
by Albert Ulrich

Biological Methods of Determining Nutrients in Soils
by Silvere C. Vandecaveye

Visual Symptoms of Malnutrition in Plants
by James E. McMurtrey, Jr.

Edited by Herminie Broedel Kitchen, Associate Editor, Soil Science

Specially priced at $2.00 per copy

Copies can be obtained from:

AMERICAN POTASH INSTITUTE, Inc.

1102 Sixteenth St., N. W. Washington 6, D. C.

See why so many FARMERS prefer it!

Ask a V-C Agent to show you some V-C Fertilizer. Look at the rich color of this properly-cured, superior blend of better plant foods. Run your hands down into the smooth, mellow mixture and let it pour through your fingers. It's mealy, loose and dry.

V-C Fertilizer is famous for its crop-producing power and its easy-drilling quality. It flows through fertilizer distributors smoothly and evenly with no caking, clogging or bridging.

The better plant foods in V-C Fertilizer are carefully selected and proportioned to become available according to the feeding schedule of the crop. That's why a V-C crop gets off to an early start of rapid growth... and then stays on the job, green and growing, vigorous and productive.

V-C Agronomists use Experiment Station and Extension Service recommendations and practical farm experience in determining the right V-C Fertilizer for each crop.

Every bag of V-C Fertilizer has behind it the research, skill, experience and resources of a national organization which has manufactured better fertilizers since 1895.

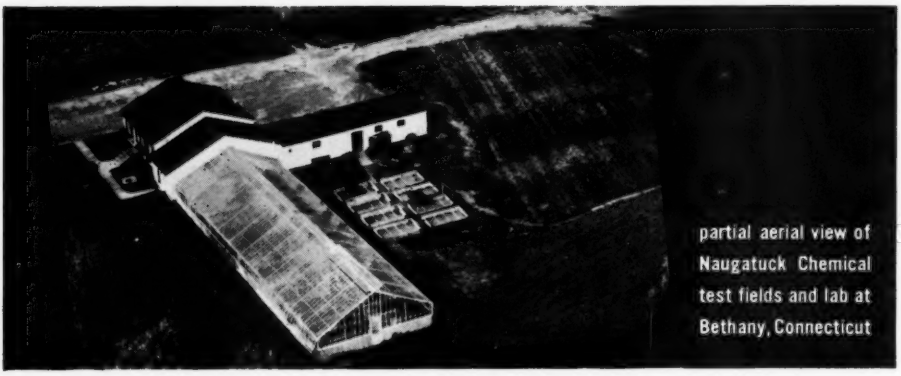
You will know why so many farmers prefer V-C Fertilizer when you see what a big difference this better fertilizer makes in crop yields and crop profits.

FERTILIZERS ®

VIRGINIA-CAROLINA CHEMICAL CORPORATION

MAIN OFFICE: 401 East Main Street, Richmond 8, Virginia

Norfolk, Va. • Greensboro, N. C. • Wilmington, N. C. • Columbia, S. C.
Atlanta, Ga. • Savannah, Ga. • Montgomery, Ala. • Birmingham, Ala.
Jackson, Miss. • Memphis, Tenn. • Shreveport, La. • Orlando, Fla.
Baltimore, Md. • Carteret, N.J. • E. St. Louis, Ill. • Cincinnati, O. • Dubuque, Ia.



partial aerial view of Naugatuck Chemical test fields and lab at Bethany, Connecticut

Here's where sales are sown!

Here's where Naugatuck chemicals begin — where Spergon®, Phygon® and Aramite* first showed signs of becoming the nationally famous products they are today.

Here's where Naugatuck Chemical's seed protectants, spray fungicides and insecticides of tomorrow must meet the tests of effectiveness, economy, plus ease and safety of use.

Yes, and here's where sales are sown! When the benefits of the Naugatuck chemicals developed here eventually reach the grower, they also reach the supplier and distributor in the form of new sales and new profits.

*U. S. Pat. No. 2,529,494

UNITED STATES RUBBER COMPANY

Naugatuck Chemical Division, Naugatuck, Conn.

producers of seed protectants, fungicides, miticides, insecticides;
Spergon, Phygon, Aramite, Synklor

Better Crops with PLANT FOOD

IF NOT DELIVERED, return to

AMERICAN POTASH INSTITUTE, INC.

1102—16th St., N. W., Washington 6, D. C.

RETURN POSTAGE GUARANTEED

Sec. 34.66, P. L. & R.
U. S. POSTAGE
PAID
Washington, D. C.
Permit No. 2283